IDA PAPER P-2459

ATCCIS WORKING PAPER 25

TECHNICAL STANDARDS FOR THE ATCCIS ARCHITECTURE

EDITION 2.0

L. B. Scheiber, *Project Leader*

August 1990

Prepared for
Office of the Assistant Secretary of Defense (C^3I)
(Theater and Tactical Command, Control and Communications)
and
Office of the Director of Information Systems for C^4,
Headquarters Department of the Army

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This Paper has been reviewed by IDA to assure that it meets high standards of thoroughness, objectivity, and appropriate analytical methodology and that the results, conclusions and recommendations are properly supported by the material presented.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	August 1990	Final

4. TITLE AND SUBTITLE
TECHNICAL STANDARDS FOR THE ATCCIS ARCHITECTURE (U), ATCCIS WORKING PAPER 25

5. FUNDING NUMBERS
MDA 903 89-C-0003

T-J1-246

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
INSTITUTE FOR DEFENSE ANALYSES
1801 N. Beauregard Street
Alexandria, VA 22311

8. PERFORMING ORGANIZATION REPORT NUMBER
IDA PAPER P-2459

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
ASD (C3I)
Room 3D174, The Pentagon
Washington, DC 20301

Director, FFRDC Programs
1801 N. Beauregard Street
Alexandria, VA 22311

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This Paper is a reprint of a document prepared by IDA in support of the SHAPE-sponsored Army Tactical Command and Control Information System (ATCCIS) Phase II study effort. ATCCIS is a common army command and control system concept for the year 2000 and beyond. This report describes a methodology, using interoperability parameters, for identifying the technical standards that will be required to support implementation of the ATCCIS architecture and for assessing the degree to which existing and emerging international standards support ATCCIS requirements. Overviews are given of standards that have been recommended for NATO's Quadrilateral Interoperability Program, STAMINA, NATO's Air Command and Control System, UK GOSIP, US GOSIP, and several applications portability profiles. The methodology described in this report is intended to be a framework for addressing interoperability questions such as: is there adequate standards coverage, are there significant overlaps among standards, and how can standards be used to ensure interoperability.

14. SUBJECT TERMS
Army, Tactical Command and Control, Interoperability, NATO, SHAPE, Open Systems Interconnection, Portability, Standards, GOSIP, Stacks, Options, Assessment, Data Communications, Data Transmission.

15. NUMBER OF PAGES
515

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	Same as Report

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301

COMMAND, CONTROL,
COMMUNICATIONS
AND
INTELLIGENCE

October 19, 1990

MEMORANDUM FOR: SEE DISTRIBUTION

SUBJECT: Technical Standards for the ATCCIS (Working Paper 25)

The Institute for Defense Analyses (IDA) has completed a review of technical standards applicable to future theater and tactical command and control systems. While scope of the IDA effort was on tactical command and control for the Year 2000 and beyond, this work appears to have potential interest for current and emerging information systems as well. The IDA paper provides an in-depth review of international and national, civil and military data communications standards that could be used to achieve interoperability and portability of systems. The methodology of the paper is based on interoperability parameters and is used to analyze the contents and relationships of open systems and other standards. This work supports OSD efforts to promote the use of civil standards, including GOSIP, to achieve open systems interconnection.

Attached is a copy of the standards analysis that has been completed under the Army Tactical Command and Control Information System (ATCCIS) Phase II program coordinated by my office in conjunction with the U.S. Army. ATCCIS is a SHAPE-sponsored study. The U.S. Army (ODISC4) provides the U.S. Delegate to ATCCIS and supports U.S. participation, including the IDA technical effort. Questions and requests for additional information can be directed to Dr. Robert P. Walker at IDA, 703-845-2462.

Richard G. Howe
Director, Theater & Tactical C3

Attachment

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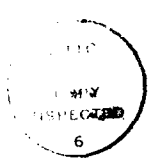

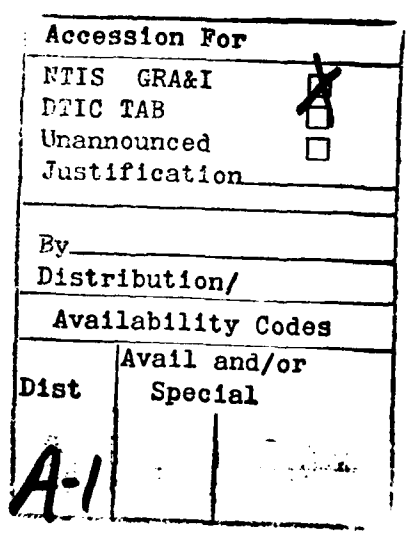

INSTITUTE FOR DEFENSE ANALYSES
Contract MDA 903 89 C 0003
Task T-J1-246

FOREWORD

(U) This paper (IDA P-2459) is a major revision of Edition 1, ATCCIS Working Paper 25 (IDA M-519). In September 1988, SHAPE distributed Edition 1 for comment to the NATO nations and other interested agencies. IDA Paper P-2459 is a reprint of Edition 2 prepared by the Institute for Defense Analyses (IDA) in support[1] of the SHAPE-sponsored Army Tactical Command and Control Information System (ATCCIS) Phase II study effort. IDA P-2459 is being used to disseminate the Working Paper to US National Commands and Agencies. Additional data and analyses will be required to complete the assessments of options and standards coverage and to extend the interoperability parameter methodology.

(U) A draft of this paper (Version 1.2A, July 1989) was submitted to the US Military Communications Electronics Board (MCEB) for review and comment by DoD Services and Agencies. Comments and suggestions received from this review have been incorporated.

(U) Background information relating to the overall ATCCIS effort is contained in the Preface of this Working Paper. It should be noted that Oxford English spelling conventions are used throughout the paper in accordance with standing NATO guidelines.

(U) The Office of the Director of Information Systems for Command, Control, Communications, and Computers (ODISC4), Headquarters, Department of the Army, provides the US delegate to the ATCCIS PWG, which consists of military, technical, and analytical representatives from France, Germany, the United Kingdom, the United States, SHAPE, and observers from the Allied Forces Central Europe (AFCENT). The ATCCIS Steering Group provides overall direction and approval of the ATCCIS PWG work effort and includes representatives from the PWG nations and commands, plus Belgium, Canada, and the Netherlands, with additional representation (observers) from the Allied Data Systems Interoperability Agency (ADSIA), the NATO Communications and Information Systems Agency (NACISA), and the Tri-Service Group for Communications Electronic Equipment (TSGCEE). The Command and Control Division, US Army Combined Arms

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1 (U) Working Paper 25 is being prepared in response to a request from the Office of the Assistant Secretary of Defense (C3I), Theater and Tactical Command, Control, and Communications under Contract MDA 903 84-C-0031, Task Order T-J1-246, UNCLASSIFIED.

Combat Development Activity, provides military expertise; the US Army Communications-Electronics Command and IDA provide technical expertise, with additional support provided by the National Institute for Science and Technology (NIST); and IDA provides analytical expertise in support of the US contributions to the overall ATCCIS effort. Further details concerning the ATCCIS Phase II study can be found in the ATCCIS Work Plan.[2]

(U) This paper should be of primary interest to those Commands and Agencies whose focus is on the technical aspects of longer-term command and control requirements. Edition 2 of ATCCIS Working Paper 25 was reviewed by a panel of field-grade officers and senior scientists representing SHAPE, AFCENT, France, Germany, the United Kingdom, and the United States prior to its distribution by SHAPE.

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2 (U) *ATCCIS Phase II Work Plan*, Edition 2, IDA Memorandum Report M-263, September 1986, UNCLASSIFIED.

PREFACE

1. (U) In 1978, NATO's Long-Term Defense Plan (LTDP) Task Force on Command and Control (C2) recommended that an analysis be undertaken to determine if the future tactical Automatic Data Processing (ADP) requirements of the nations, including that of interoperability, could be obtained at a significantly reduced cost when compared with the approach that had been adopted in the past. The Task Force also recommended that the analysis should determine whether tactical ADP systems could be developed according to technical standards prescribed by NATO and agreed upon by the nations.

2. (U) In early 1980 the then Deputy Supreme Allied Commander Europe initiated a study to investigate the possibilities of implementing the Task Force's recommendations. Three nations, those with experience in fielding automated tactical command and control information systems, participated in Phase I of the study, with Supreme Headquarters Allied Powers Europe (SHAPE) as leader and coordinator. The study group reported, at the end of Phase I, that the nations could increase interoperability and potentially reduce costs by using a common development approach. It was also recommended that Phase II, the definition of an operational and technical concept and an analysis of the likely impact of a common Central Region (CR) (tactical) command and control information system, should be initiated.

3. (U) The ATCCIS study, under the direction of a steering group chaired by SHAPE and consisting of representatives from the CR nations and Allied Forces Central Europe (AFCENT), was established in 1984. Concurrently, a permanent working group (PWG) was formed which consists of military, technical, and analytical representatives from France, Germany, the United Kingdom, the United States, SHAPE and AFCENT, and technical support from SHAPE Technical Centre (STC) to progress the Phase II effort. The Phase II study effort commenced in January 1985 and terminates in October 1990.

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CONTENTS

LIST OF FIGURES

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LIST OF TABLES

ATCCIS Working Paper 25

TECHNICAL STANDARDS FOR THE ATCCIS ARCHITECTURE

1. INTRODUCTION

1.1 Derivation

(U) This paper derives from Working Papers (WPs) 22, 23, and 24 [Ref. 1-3]. WP 22 defines the basic concepts necessary for the definition of the architecture for the Army Tactical Command and Control Information System (ATCCIS), a common army command and control system concept for the year 2000 and beyond. WP 23 defines the ATCCIS services needed to meet the imposed military requirements. WP 24 specifies an architecture designed to satisfy the ATCCIS operational requirements.

1.2 Purpose

(U) The purpose of this working paper is to identify the technical standards that will be required to support implementations of the ATCCIS architecture. In this working paper, existing and planned standards appropriate to the ATCCIS facilities are surveyed to the level of detail necessary to confirm a reasonable basis for the future support of the ATCCIS requirements. Relevant standards are identified, but no recommendations for selecting standards are considered. Gaps in current and planned standards coverage, which may require some developmental effort, are identified and will be passed to the appropriate standards defining body within NATO. WP 25 also offers guidance in ensuring adequate coverage by the set of standards employed at the time of implementation.

1.3 Scope

(U) This working paper presents information and analyses that are intended to support implementation of the ATCCIS architecture, especially of that minimum part of ATCCIS functionality called basic interoperability (defined in WP 23). WP 25 provides a broad overview of the existing and developing technical standards applicable to ATCCIS.

(U) The scope of the analysis of standards, which is the focal point of this paper, is broad, extending to international and national, commercial and military standards.

However, the emphasis is on international commercial standards with military enhancements.

1.4 Information Sources

(U) This assessment is based primarily on a review of standards for open systems developed by the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the International Telegraph and Telephone Consultative Committee (CCITT). Since ISO/IEC has decided to use the profiles of standards being developed by regional standards workshops, the primary sources for profiles are those workshops. Use of open systems standards in NATO is the responsibility of the Tri-Service Group on Communications and Electronic Equipment (TSGCEE) Subgroup 9 (SG9) on Data Processing and Distribution; thus, TSGCEE SG9 draft STANAGs, *NATO Technical Interface Standards (NTIS) Transition Strategy* [Ref. 4], and working documents form the basis of the assessment of military use of open systems standards.

(U) The cut off date for information contained in Edition 2 of WP 25 is July 1990. The primary impact of early publication is that the progression of some standards to committee draft (CD), draft international standard (DIS), and international standard (IS or ISO) status may not be fully reflected herein.[1]

1.5 Structure of the Paper

(U) Chapter 2 describes the methodology employed in WP 25 to identify and analyse standards relevant to ATCCIS. This methodology includes the use of interoperability parameters to specify options and choices within the standards. Chapter 3 provides an overview of the assessment and includes a description of the reference model for open systems interconnection (OSI) that is the basis for most of the current international commercial data communications standards activities. Chapter 3 also identifies the key elements of the ATCCIS architecture, namely the four facilities that make up the Basic Ensemble for ATCCIS: Transfer Facility (TF), Service Control Facility (SCF), Data Management Facility (DMF), and System Management Facility (SMF). Analyses of the applicable standards for these four facilities are presented in Chapters 4-7, respectively. Technical standards that potentially apply to all four facilities are reviewed in Chapter 8. Such standards include security and OSI management.

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[1] (U) Significant contributions have been received from representatives to TSGCEE, the British Standards Institute (BSI), the American National Standards Institute (ANSI), the National Institute of Standards and Technology (NIST), OMNICON, and Technology Appraisals.

(U) Figure 1 identifies the roles of each of the chapters. Chapters 4-8 address basic interoperability. Chapters 2 and 3 are essential to understanding the assessment, but the remaining chapters are generally independent and can be read in any order.

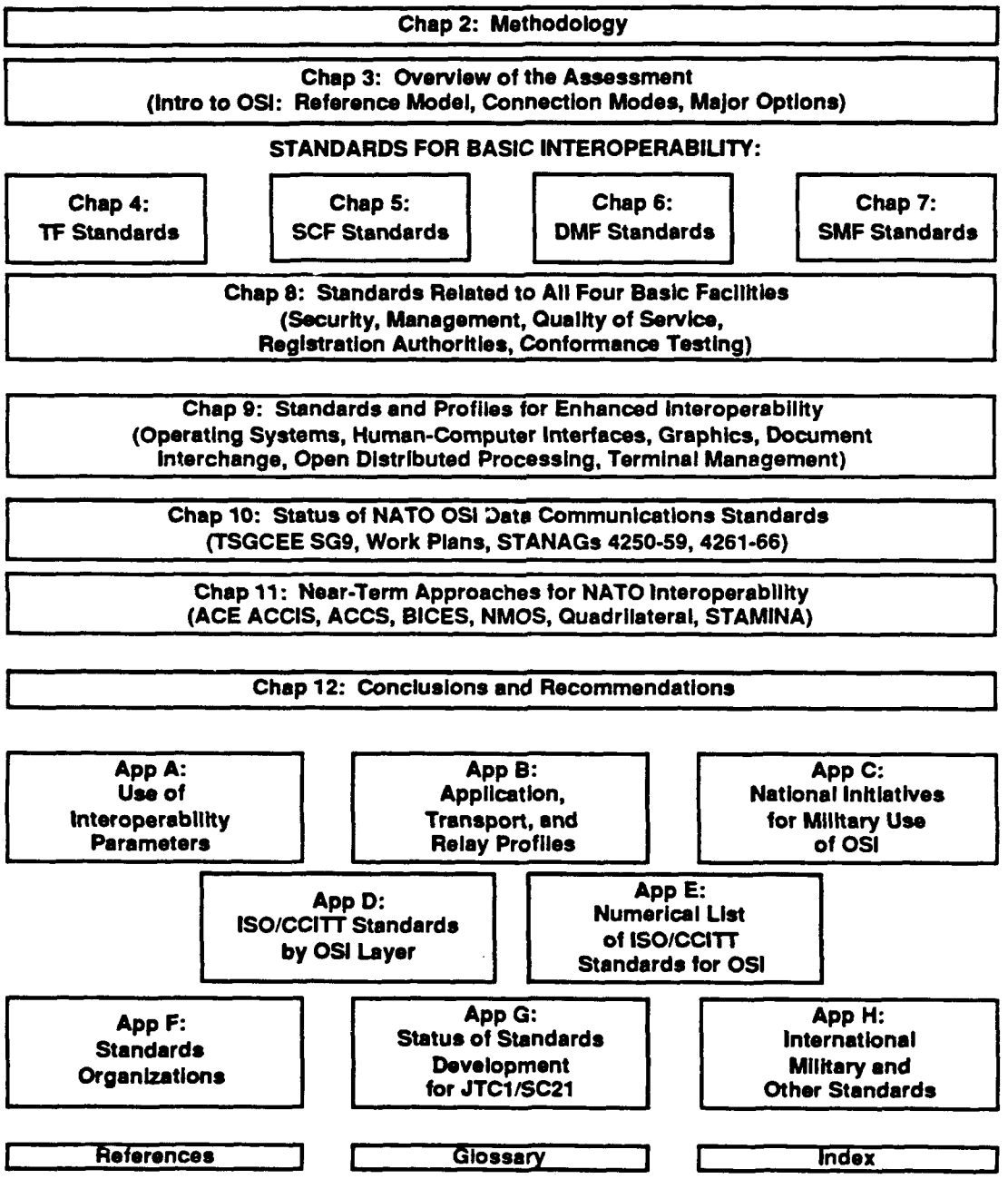

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Figure 1. (U) Organization of Working Paper 25

(U) Chapter 9 discusses technical standards that would appear to go beyond those required to achieve basic interoperability and would therefore be applicable to enhanced interoperability. Specifically, Chapter 9 discusses standards that could be considered for operating systems, human-computer interfaces (HCIs), graphics, document interchange, distributed transaction processing (TP), open distributed processing (ODP), and terminal management (TM). Standards for some of these areas go beyond the OSI Reference Model. Further, Chapter 9 identifies some of the profiles recommended by international and national standards bodies for applications portability and interoperability of similar products by different vendors.

(U) Chapter 10 provides a review of the plans by NATO bodies to specify standards and military enhancements to international commercial technical standards for OSI. A detailed review of the NATO OSI data communication Standardization Agreements (STANAGs) being developed by TSGCEE is included in Chapter 10. A review of six NATO projects is provided in Chapter 11, which identifies the standards to be used for interoperability. Conclusions and recommendations of this study are given in Chapter 12.

(U) Several appendixes, some lengthy, are provided as reference material. Appendix A expands the discussion of the interoperability parameter methodology and applies the approach to some commonly used standards (RS-232, RS-423, STANAG 4202, and CCITT X.25). Appendix B summarizes the application, transport, and relay functional profiles identified for use in NATO. Appendix C provides examples of TSGCEE SG9 and national initiatives to address the military use of OSI standards. A compilation of technical standards being developed by ISO and CCITT is given in Appendixes D and E, the former listed by layer of the OSI Reference Model and the latter listed numerically. Appendix F identifies the role and (in some cases) the standards responsibility of international and national, both civil and military, standards bodies. Appendix G provides some detailed information on the work plans for one of the major subcommittees (SC21) of the Joint Technical Committee Number 1 (JTC1) of ISO and IEC. Finally, Appendix H identifies STANAGs and other military and commercial standards being developed for use in open systems.

2. METHODOLOGY

2.1 Background for ATCCIS

(U) This chapter describes the methodology employed to identify the group of existing and planned standards required to support ATCCIS functionality and to assess the completeness of standards coverage for the time period of ATCCIS implementation. The methodology is illustrated in Figure 2.

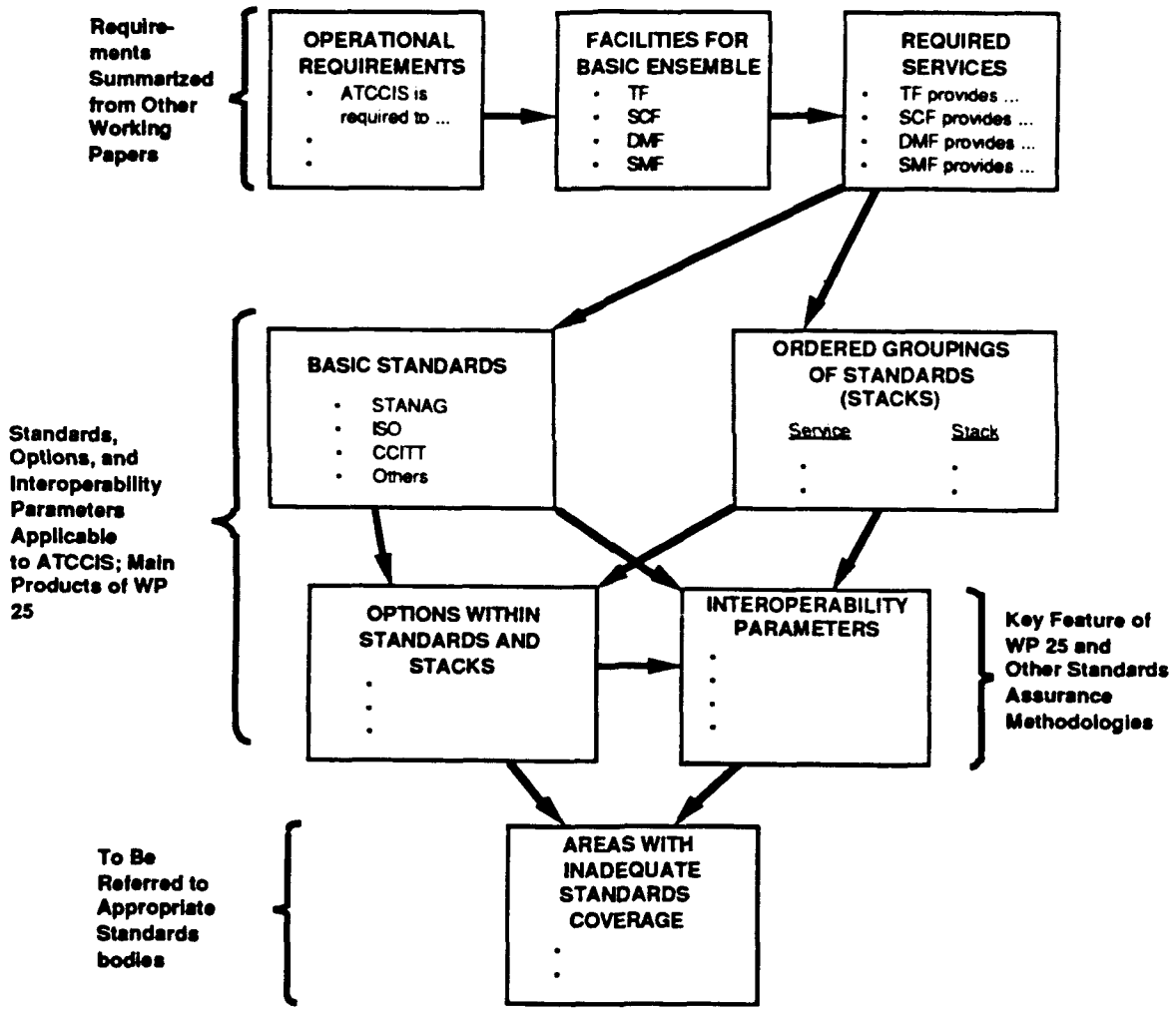

Figure 2. (U) Overview of the Methodology

2.1.1 Basic Facilities

(U) WP 24 identifies the ATCCIS architecture in terms of facilities whose combined functionality fulfills the ATCCIS operational requirements. The Basic Ensemble, which provides the minimum required operational capability (called basic interoperability), is composed of four facilities, each analysed individually in subsequent chapters:

(1) Transfer Facility (TF). The TF provides functionality to allow different parts of an ATCCIS system, or two ATCCIS systems, to invoke services one from another. TF includes data transfer protocols, services of the communications infrastructure, and services to manage data transfer and communications (see Chapter 4).

(2) Service Control Facility (SCF). The SCF provides functionality to control interactions among all other ATCCIS facilities (see Chapter 5).

(3) Data Management Facility (DMF). The DMF provides functionality to ensure the proper management of data, and to ensure that there is a consistent representation of data and data relationships across all ATCCIS-conformant systems (see Chapter 6).

(4) System Management Facility (SMF). The SMF provides functionality supplementary to the management services of the TF and DMF for control of part or all of an ATCCIS system (see Chapter 7).

The Basic Facilities provide the three mechanisms necessary for basic interoperability: providing end-to-end transfer of data; managing the storage, retrieval, and interpretation of data; and managing these mechanisms as the minimum capability to support basic interoperability.

2.1.2 Basic Interoperability

(U) Basic interoperability is the capability to allow two systems to exchange data and to preserve the meaning and relationships of the data exchanged. Capabilities, such as portability of applications software, that support a more general concept of interoperability constitute enhanced interoperability. The focus of this working paper is on basic interoperability and, therefore, on the technical standards applicable to the four Basic Facilities.

2.1.3 Features of the Architecture

(U) ATCCIS technical analyses have concluded that an ATCCIS-conformant system must be a transaction processing system with a partitioned, partially replicated database capable of supporting applications and maintaining the capability for consistent interpretation of the data across organizational boundaries (see Section 6.1.1).

(U) The ATCCIS architecture will be defined by adopting existing or emerging standards wherever and whenever possible. Further, when such a standard cannot be found ATCCIS will identify the requirement for a standard to be developed and will pass such a requirement to the appropriate standards defining body within NATO. Each facility in the ATCCIS architecture is a logical entity that provides a set of related services; implementation of a facility is not defined by the architecture and is a national responsibility for each system. This paper identifies standards (and options within standards) that are applicable to each facility, but the paper does not recommend any specific standard or groups of standards. Selection of appropriate standards, as well as the basic design choices implicit in the standards and options within standards, will be made by agreement prior to implementation decisions.

2.2 Identification of Base Standards

(U) Following a review of the required services for each facility, the next step is to identify the base standards appropriate for that facility. These standards may come from international, NATO, national military, or national non-military standards bodies, and they may be existing or planned. High-level options within standards applicable to ATCCIS are identified.

(U) For many functions, there are several interrelated standards that must be used together to provide the required services. In most cases there is an order or hierarchy among these standards in which the lower levels are closer to physical means, and higher levels are associated with applications that are independent of the physical means. An ordered grouping of standards is called a stack. A profile is a stack of standards for which the interoperability parameters are partially or fully specified (profiles usually represent agreements among implementors). Where applicable to services required by ATCCIS, stacks will be constructed and illustrated in tables or figures.

2.3 Assurance of Coverage

(U) Assurance of adequate standards coverage is addressed in three ways. First, WP 25 checks for the existence of standards that generally support each specific ATCCIS function. Requirements for which no existing or planned standard seems to exist, or for which existing standards do not seem to be adequate, are identified so that these needs may be referred to the appropriate NATO standards defining body.

(U) On a more specific level, a methodology for assuring adequate standards coverage through detailed analysis has been developed. An interoperability parameter approach is defined that begins with the identification of the system design parameters

whose control is required to achieve interoperability. The assembled parameters act as a checklist for interoperability since each interoperability parameter must be controlled by a suitable standard. The purpose of an analysis using interoperability parameters is to recognize and examine all relevant quantities and characteristics in a direct manner, instead of assuming that existing or draft standards will provide adequate coverage of the quantities. Appendix A discusses this approach in more detail. NATO's TSGCEE Subgroup 9 (SG9) has developed a format, called a functional profile, for specifying stacks and interoperability parameters. Functional profiles are discussed in Section 9.3, and examples are provided in Appendix B.

(U) In the third step of the coverage analysis, the array of standards identified that could support ATCCIS is compared with plans for near-term efforts to check for completeness. Near-term efforts include: developing NATO C2 systems, such as the Air Command and Control System (ACCS); conducting multilateral interoperability demonstrations, such as the Quadrilateral Interoperability Programme (QIP); and harmonizing the standards and stacks recommended by several national agencies, such as government open systems interconnection profiles (GOSIPs) and applications portability profiles recommended by international consortia such as X/Open. National initiatives for military use of OSI standards are reviewed in Appendix C. In addition to providing a check on completeness of ATCCIS applicable standards, some of these near-term efforts are of interest because they represent transition strategies for moving to open environments for information processing and exchange.

3. OVERVIEW OF THE ASSESSMENT

3.1 Introduction

(U) One of the underlying principles for the ATCCIS concept is that specifying standards is essential to ensuring interoperability. However, it cannot be emphasized too strongly that specifying standards alone will not guarantee interoperability. Indeed, every standard has a number of system and design parameters or interoperability parameters whose values may need to be fixed in the design phase of implementation. To ensure interoperability, each of these interoperability parameters must also be specified and controlled. Some interoperability parameters are very general and may be used to specify a class of options or mode of operation. Other interoperability parameters may be very detailed, such as restrictions on timing, format size, or bandwidth.

(U) Because each standard is a reflection of the degree to which agreement can be reached in a service area, many important attributes (i.e., interoperability parameters) are often left unspecified or unaddressed. As agreements are reached over time, the standards will improve by addressing more functionality and harmonizing conflicting approaches. In cases where standards identify extensions and other types of options, great care must be taken in standards specification and interoperability parameter control to ensure that whenever an extension or option is permitted, every implementation of the related service also supports this extension or option. This principle is especially important in achieving not only interoperability but also portability of applications from one environment or implementation to another, such as is needed when operating systems, data management systems, interface packages, and hardware are upgraded.

(U) There are three major classes of standards applicable to ATCCIS:

- Standards for bearer circuits
- Standards and profiles for OSI
- Standards for higher level applications and data representation.

The classes are shown in Figure 3. Interoperability parameters will be drawn from all three classes of standards, both from the minimum requirements and from the options within the standards. As will be shown in subsequent chapters, the TF requires standards in the first two classes, whereas the other three facilities in the Basic Ensemble (SCF, DMF, and SMF) are addressed primarily by standards for higher level applications and data representation. One of the layers of OSI standards (the application or highest layer) has standards not only for the TF but also for the other three facilities. Although not indicated in Figure 3, there is a potential overlap among the standards applicable for the TF and those

for the other facilities. Further, Figure 3 does not explicitly identify higher-level functional or military applications that go beyond basic interoperability and may be implemented by some or all of the ATCCIS components. Whenever possible, diagrams such as the one in Figure 3 will be provided to show which standards are required for each of the applicable service options and profiles; in some cases, the service options will be identified at the bottom of the diagram. Ordered groupings or stacks of standards for a particular service will also be shown by connecting blocks of standards with solid vertical lines.

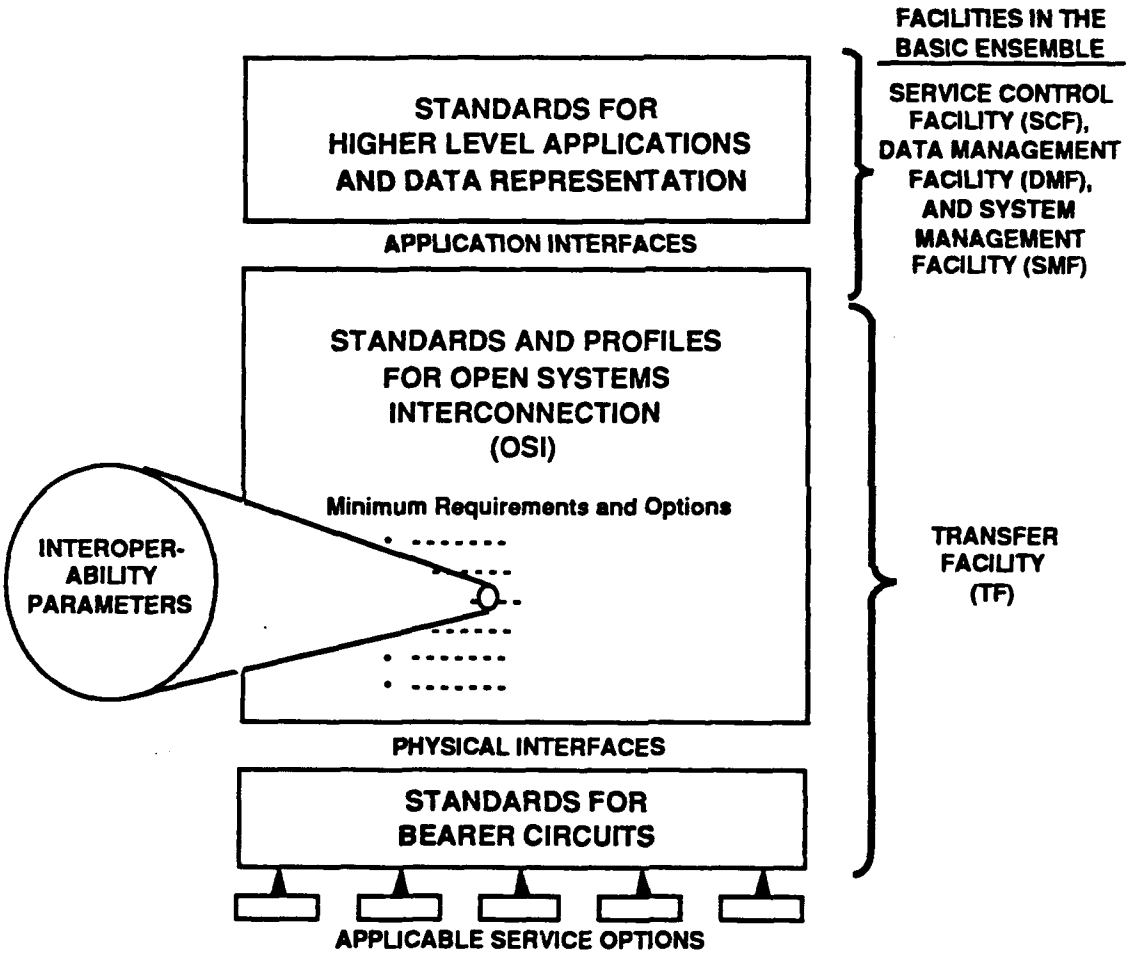

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Figure 3. (U) Classes of Standards and Their Relation to ATCCIS Facilities

3.2 Relationship of ATCCIS Facilities to OSI Layers

(U) The first step of the analysis consists of the classification of the facility of interest in terms of the OSI Reference Model developed by ISO. In this model, the functions required for interoperation between data processing systems are divided into seven layers [Fig. 4]. Layers 1-4 are called the lower layers and are primarily concerned with control of the data transmitted between data processing systems. The Physical Layer (Layer 1) controls data transmission over physical media (e.g., wire). The Data Link Layer (Layer 2) augments the Physical Layer function by providing transmission error control along segments of the transmission network. The Network Layer (Layer 3) controls the data transmission route. The Transport Layer (Layer 4) provides protocols for moving data between end systems on the network.

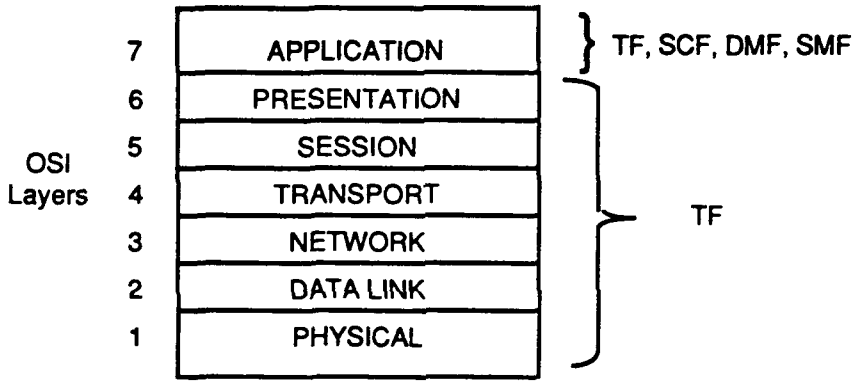

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Figure 4. (U) The Seven-Layer Model for Open Systems Interconnection

(U) Layers 5-7 are called the upper layers and are concerned with the network's interface to the end systems. The Session Layer (Layer 5) establishes a logical connection between communicating end systems. The Presentation Layer (Layer 6) ensures that data from the network is presented to the user in an intelligible form. The Application Layer (Layer 7) provides services to the application programs that may request support from other systems on the network in order to complete their user-dictated tasks.

3.2.1 Basic Options in OSI Standards

(U) Options for international standards that support the OSI model are often designated by grouping the OSI layers into two classes: application options and transport options [Fig. 5]. Using the definitions of Reference 4, the combined Layers 5-7

will be considered to offer application options, while Layers 1-4 offer transport options. A separate category of relay options that provides interfaces between subnetworks will also be considered. Relay options normally are provided by Layers 1-3 [Fig. 6]. Examples of these options are illustrated in Appendix B.

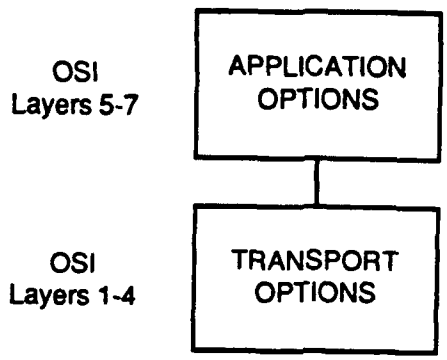

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Figure 5. (U) Composition of an OSI System

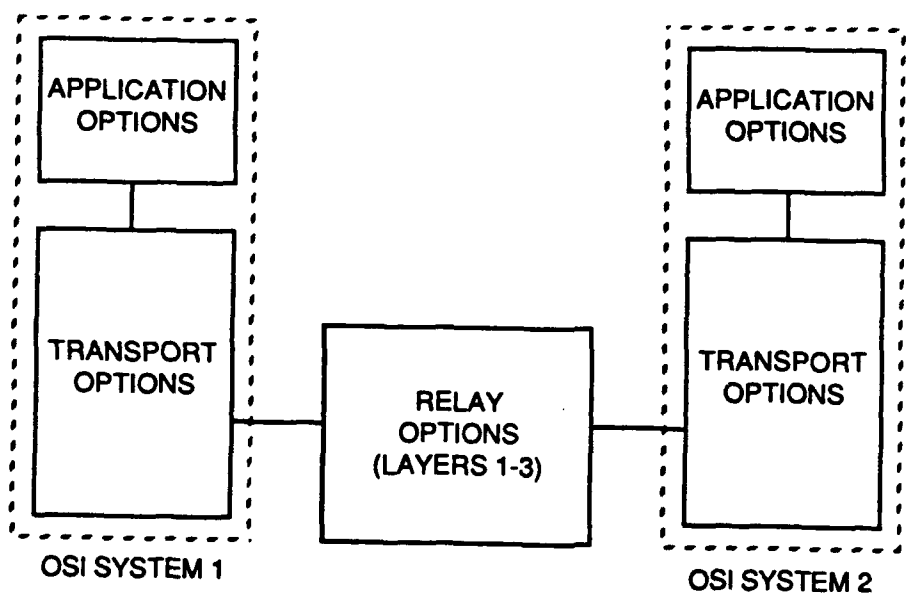

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Figure 6. (U) The Role of a Relay

(U) OSI standards are being developed through ISO and CCITT. ISO/IEC JTC1 was formed to progress international standards on information processing.[2] Study Committee 21 (SC21), Standardization on Information Retrieval, Transfer, and Management for Open Systems Interconnection, is responsible for OSI upper layer standards. There are three stages for development of ISO standards. Results of a working group are issued as a Committee Draft (CD), formerly a Draft Proposal (DP). When approved by the cognizant subcommittee (e.g., SC21), the standard is issued as a Draft International Standard (DIS). When approved (unanimously, if possible) by a technical committee (e.g., JTC1), it is issued as an International Standard (IS or ISO). The CCITT has ongoing study groups that issue new and revised standards every 4 years. CCITT standards issued in 1984 are known as the "red" books; the 1988 standards have blue covers (the "blue" books).

(U) The major application, transport, and relay options in OSI being developed by ISO, IEC, and CCITT are listed in Table 1. The transport and relay options are addressed in Chapter 4 on the Data Management Facility. The application options are briefly addressed below and discussed more fully in Chapters 4-9.

3.2.2 Application Options Applicable to the Basic Facilities and to Enhanced Interoperability

(U) The top portion of Figure 7 identifies the application options applicable to the Basic Facilities and the chapters that discuss each of these options.

(U) Each of the following standards appears to be applicable to the Transfer Facility: Message Handling System (MHS), File Transfer and Management (FTAM); Directory; Application Service Elements (ASEs) such as the Reliable Transfer Service Element (RTSE), the Association Control Service Element (ACSE), and the Remote Operations Service Element (ROSE); and all the OSI standards at Layers 1 to Layer 6. The only standard applicable to the Service Control Facility is the Portable Operating System Interface for Computer Environments (POSIX). Standards applicable to the Data Management Facility are the Database Languages NDL and SQL; Remote Data Access (RDA); ASEs such as ROSE and Commitment, Concurrency, and Recovery Control (CCR); Information Resource Dictionary System (IRDS); distributed Transaction Processing (TP), and Open Distributed Processing (ODP). Standards applicable to the System Management Facility are still to be determined (TBD).

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2 (U) JTC1 replaced ISO Technical Committee 97, Information Processing Systems.

Table 1. (U) Application, Transport, and Relay Options Offered by OSI Standards

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BASIC APPLICATION OPTIONS

- Primary Services:
  - Message Handling:
    - Message Handling Service (MHS) [CCITT]
    - Message-Oriented Text Interchange System (MOTIS) [ISO]
  - File Transfer Access and Management (FTAM)
  - Telematic Services (Teletex, Telefax, Textfax)
  - Virtual Terminal (VT)
  - Job Transfer and Manipulation (JTM)
- Other Services:
  - Directory
  - Transaction Processing (TP)
  - Open Distributed Processing (ODP)
  - Remote Data Access (RDA)
  - OSI Management
  - Application Service Elements (ACSE, RTSE, ROSE, CCR)
  - Information Resource Dictionary System (IRDS)
  - Office Document Architecture (ODA)
  - Computer Graphics Metafile (CGM) and Interface (CGI)
- Transmission Mode:
  - Connection Oriented (CO)
  - Connectionless (CL)

BASIC TRANSPORT OPTIONS

- Subnetwork Types:
  - Circuit Switched Data Network (CSDN)
  - Packet Switched Data Network (PSDN)
  - Dedicated Line (Point-to-Point Subnetwork)
  - Switched Telephone Network (STN)
  - Integrated Services Digital Network (ISDN)
  - Local Area Network (LAN)
- Transmission Modes:
  - Connection Oriented
  - Connectionless
- Transmission Media Interfaces:
  - Wire
  - Radio
  - Fiber Optic Cable
  - Microwave
  - Infrared

BASIC RELAY OPTIONS

- LAN to LAN
- LAN to Wide Area Network (WAN)
- WAN to WAN
- LAN to WAN to LAN

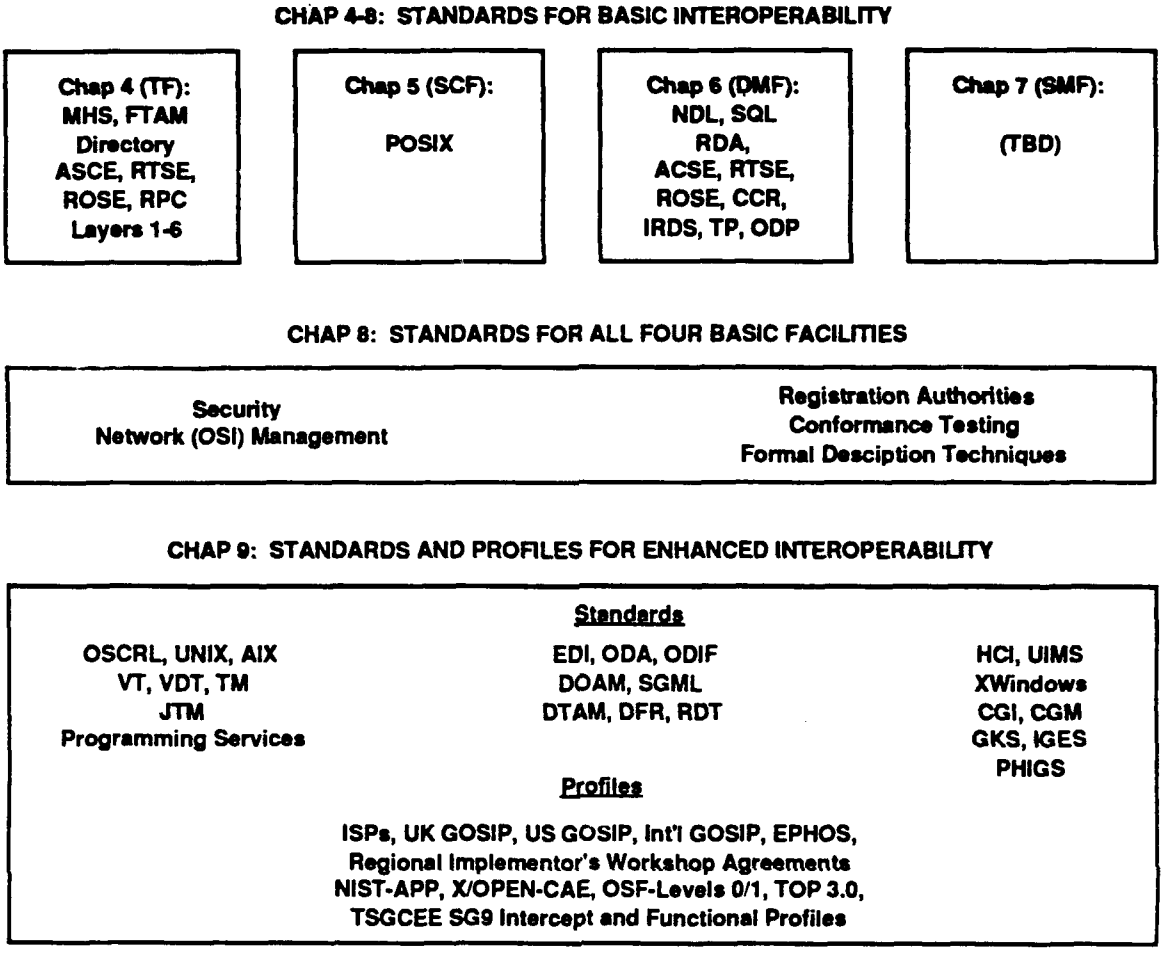

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Figure 7. (U) Standards Applicable to the Basic Facilities and Applicable to Enhanced Interoperability

(U) The remaining applications in Table 1, together with additional standards that fall outside the OSI Reference Model, are shown in the bottom portion of Figure 7 as applicable to enhanced interoperability and therefore are discused in Chapter 9. Two of these are controversial. The ATCCIS PWG is evaluating whether Virtual Terminal (VT) and Job Transfer and Manipulation (JTM) are to be considered relevant to basic interoperability for ATCCIS. (VT would provide a capability to simultaneously perform batch and interactive processing. JTM would permit one component to task another component to perform data processing normally conducted only at the first component.) It is possible that these two services could be determined inappropriate for the required data communications standards for use between national corps headquarters; instead, the

services could be implemented as a national prerogative in support of enhanced interoperability. Othe application options that are considered applicable to enhanced interoperability are:

- Operating system standards, such as Operating System Command and Response Language (OSCRL), UNIX™, and AIX™
- Display terminal standards, such as Visual Display Terminal (VDT) and Terminal Management (TM)
- Programming service standards, including Ada, Pascal, C, and FORTRAN language bindings for other standards and system definition and design support tools
- Document interchange standards, such as Electronic Data Interchange (EDI), Office Document Architecture (ODA), Office Document Interchange Format (ODIF), Distributed Office Applications Model (DOAM), and Standard Generalized Markup Language (SGML)
- File transfer standards that provide capabilities similar to FTAM, such as the Document Transfer and Manipulation (DTAM), Document Filing and Retrieval (DFR), and Referenced Data Transfer (RDT)
- Human-computer interface (HCI) standards, including X-Windows and the User Interface Management System (UIMS)
- Graphics standards, such as Computer Graphics Interface (CGI), Computer Graphics Metafile (CGM), Graphical Kernel System (GKS), Initial Graphics Exchange Specification (IGES), and Programmer's Hierarchical Interactive Graphical System (PHIGS).

3.2.3 Connection-Oriented and Connectionless-Oriented Transmission Modes

(U) One of the important issues that must be considered when reviewing OSI standards is the choice between connection-oriented (CO) services (also called "virtual circuit" services) and connectionless-oriented (CL) services (also called "datagram" services). Each of the seven OSI layers, except the Physical Layer, may be CO or CL. (The Physical Layer has no connection orientation.) The OSI Reference Model recommends that the upper four layers be either all CO or all CL. The following paragraphs, based on References 5-8, address some prominent distinctions between these two classes of services.

(U) The basic difference between CO and CL service is that CO service requires that an explicit relationship be established between the interacting peer entities, while in CL service no such explicit relationship occurs. A connection preserves the state of peer-to-peer communications from one data transfer to the next, storing and

distributing information regarding the connection within the service provider, while the CL transmission does not. In CO service the relationship may be real--such as a dedicated circuit--or virtual, such as a particular path from node to node between peer entities in a CO packet-switched service. In the latter case the path would be agreed upon before data transfer begins and would remain unchanged during the transfer. A heuristic example of CO service is any national public telephone service; the regular delivery postal service is a heuristic example of a CL service. In CO service, there is the possibility of error checking and retransmission of data packets known to be in error, at the cost of some amount of overhead for each packet.

(U) CO service has three phases: connection establishment (set up), data transfer, and connection release (call termination). The route of each data packet is determined by the state of the network during the call set up and remains static for the duration of the connection. Since the state information is maintained for each established connection and the route of data packets is static, the data units are freed from the requirement to carry the full address of the required destination. The CO explicit relationship is established during the negotiation portion of the set-up phase and before the transfer phase. CO service provides for negotiation of the form of transmitted data and may maintain sequence and flow control. Error handling may also be supported. The overhead invested in setting up and maintaining a CO connection pays off when the data transfer phase is relatively long. The CCITT Recommendation X.25 for packet switching for wide area networks (WANs) is an example of a connection-oriented protocol.

(U) In contrast, CL service has only one phase--namely, data transfer. The form of the data transferred must be pre-arranged between peer entities. Sequencing, flow control, and error handling are not supported by the CL service, but are instead the responsibility of the interacting peer entities. Sometimes referred to as a "datagram" service, CL service requires each data unit to be self-contained; there is no relationship between individual data unit transfers.

(U) While the service mode at each of the six highest OSI layers may be CO or CL, crossover between the two types of service usually occurs only at the Network Layer (Layer 3). In these cases, the connection orientation of the Application Layer (Layer 7) agrees with the connection orientation of Layers 4, 5, and 6; further, the connection orientation of Layers 2 and 3 also agrees, but this orientation may differ from that of the higher layers. The rationale for maintaining the service mode (CL or CO) throughout Layers 4-7 is based on the recommendation of the ISO Reference Model for simplifying system and protocol complexity, specifically that the features at one layer should not be negated by the unavailability of similar services at another layer. The goal of

the OSI Reference Model is to limit the amount of *a priori* information exchanged between end systems regarding services used to communicate, which is best met by limiting the mixing of service modes. The ISO/IEC standards for the four cases of connection orientation of the transport and network services are:

- ISO 8602 for CL transport and CL network
- ISO 8602 for CL transport and CO network
- ISO 8073 for CO transport and CO network
- ISO 8073 DAD 2 for CO transport and CL network.

(U) The many resulting combinations of service are useful in different circumstances. In general, CO service is beneficial when long-lived connections with extensive data transfer are anticipated. File Transfer, Access, and Management (FTAM) is an example of an application that would likely benefit from a CO connection. However, CL service may be appropriate for military applications that require robust networks capable of continuing data transfer even as some nodes are taken out of service, especially for the lower layers (network and data link). References 5 and 7 give some additional examples of cases for which CL service is appropriate, even for the upper layers. Included are: inward data collection from the sampling of data sources, broadcast messages, some distributed transactions, some real-time transmission applications, and cases in which one or more communicating peers are mobile.

(U) The cases in which Layers 2 through 7 are all either CO or CL are more straightforward than cases with upper and lower layers of different orientation. If CL upper layers operate over CO lower layers, the full functionality of the lower layers is not employed; the application in this case does not enjoy the amenities of CO service.

(U) The OSI standards supporting CO service were the first to be developed and are nearly complete. Until recently, standards supporting the lower layer CL service were more advanced than those supporting upper layer CL services. CL protocols for the Transport Layer (ISO 8602), Session Layer (ISO 9548), and Presentation Layer (ISO 9576) are complete.

(U) Choice of connection orientation affects the structure of the Network Layer and to some degree the performance of services in the network and Transport Layers. The Network Layer is divided into three sublayers (ISO 8648, *Internal Organization of the Network Layer*). From top to bottom they are the Subnetwork Independent Convergence Protocol (SICP), the Subnetwork Dependent Convergence Protocol (SDCP), and the Subnetwork Access Protocol (SAP). This structure is preferred by many European members of NATO. In a CL network, the Network Layer is divided

into two sublayers: Internetwork Protocol (IP) and Subnetwork Specific Protocol (SSP), where the IP focuses on unreliable internetwork transfer of information while the SSP focuses on the reliable transfer of individual data units across the supporting networks. The CL approach is favored by the US [compare the OSI profiles recommended by the UK and the US given in Section 9.3.3, noting that ISO Class 4 Transport Protocol (TP4, discussed below) provides services for CL networks]. In the CL model, end-to-end responsibilities are placed in the network sublayers, whereas in the CO approach the end-to-end requirements are placed in the Transport Layer. One drawback of using TP4 over a CO network is the size and complexity of the implementing code. For this and other reasons, many implementors of CO stacks do not support TP4. Section 6 of Reference 8 provides an analysis of the impact of the choice of CL or CO mode on the interconnection of heterogeneous military networks.

(U) As in the Network Layer, there are significant differences in the protocols for the Transport Layer in connectionless and connection-oriented modes. The CL transport protocol (TP) makes use of only a subset of the CO network services, while the CO TP makes use of all the CO network services. The CL transport service is not expected to provide ordered delivery, flow control, or error control. Hence, the CL TP is very simple and requires only a single type of transport protocol data unit (TPDU). There are, however, five classes of the CO TP [Ref. 9]:

- Class 0: Simple class, oriented for Teletex (upgrade to CCITT T.70)--connection flow control is based on network flow control, and connection release is based on release of the network connection
- Class 1: Basic error recovery class, designed to run on a CCITT X.25 network and provide minimal error recovery for network-signalled errors--TPDUs are numbered so that they can be resequenced
- Class 2: Multiplexing class, an enhancement of Class 0 that still assumes a highly reliable network service--has the ability to multiplex multiple transport connections onto a single network connection
- Class 3: Error recovery and multiplexing class, provides the union of the capabilities of Class 1 and Class 2.
- Class 4: Error detection and recovery class--assumes that the underlying network service is unreliable, in particular that the TPDUs may be lost or arrive out of sequence--provides for TPDU retransmission, duplicate detection, flow control, connection establishment and termination, and crash recovery.

Of the five CO TP classes, only Class 4 can make use of a CL network service. Ten types of TPDUs are used to provide CO transport services.

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4. THE TRANSFER FACILITY (TF)

4.1 Description of the TF

(U) As defined in WP 24, the TF is the logical entity in the Basic Ensemble that binds together all ensembles[3] in ATCCIS. As such, it supports the transmission of service requests between ensembles.

(U) A simplified block diagram of the ATCCIS architecture is shown in Figure 8. It shows the relationship between the TF and the other facilities in a Basic Ensemble. The Basic Ensemble is highlighted with bold lines. Application-level facilities (ALFs), which provide functional support to the users beyond basic interoperability, are included with Other Facilities. Figure 8 shows that the DMF, SMF, and SCF each appear in all the ensembles, whereas the TF is considered to be a facility that extends across all the ensembles. Ensembles A and B can be thought of as the facilities at two physical locations in two ATCCIS components. The TF includes the services for the bearer circuits (i.e., communications media) as well as for OSI. The services of the bearer circuits are depicted in Figure 8 as the portion of the TF that connects Ensembles A and B.

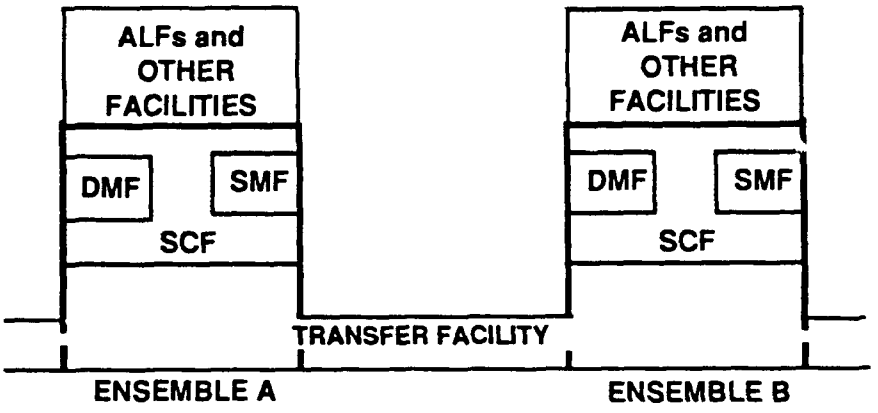

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Figure 8. (U) Facilities of the ATCCIS Architecture

3 (U) An ensemble is [WP 24] a set of standard facilities that includes, as a minimum, the four basic facilities (TF, SCF, DMF, and SMF). An ensemble is a logical entity that will be implemented on an ATCCIS component and thus has the intrinsic property of being associated with a location. Only one ensemble can be implemented on any one ATCCIS component.

(U) The TF provides a variety of services for transferring data from one component to another. Some of these services are necessarily defined [WP 24, Annex D] by reference to international standards, such as the standards for MHS. In these cases, the specification of the TF does not indicate the services to be provided, but will point to the appropriate standard.

4.2 OSI Reference Model, Interworking, and Application Layer Structure

(U) This section summaries the elements of the OSI Reference Model, interworking of layers, and the structure of the Application Layer. It also addresses the characteristics of distributed applications and architectural standards work being performed for distributed aspects of applications.

4.2.1 Status of OSI Reference Model, ISO 7498

(U) The OSI Reference Model has four elements: *Basic Reference Model* (ISO 7498), *Security Architecture* (ISO 7498-2), *Naming and Addressing* (ISO 7498-3), and *Management Framework* (ISO 7498-4). Connectionless-mode aspects were originally addressed as Addendum 1 to ISO 7498. Multipeer Data Transmission (MPDT) is addressed as Addendum 2 and Upper Layer Architecture (ULA) as Addendum 3.

(U) Balloting for SC21 N 3287,[4] *Proposed Draft Addendum 2 on MPDT* (ISO 7498-1/PDAD2), ended 15 July 1989. Work in ISO on MPDT has been suspended in SC21/WG1, since the nations did not demonstrate specific interest in continuing this work. The completed work is planned to be released as a technical report. New work in ISO on MPDT may come in the form of standards for multi-party communications (MPC), defined as information distribution within groups of end open systems. A May 1990 Canadian contribution to SC21 identified the basic driving forces for MPC as the coordinated interworking of more than two application processes in a single activity and use of inherently shared resources of certain subnetwork types. "Group" processing was identified as one of the next "hot topics" for standardization and was expected to include such activities as conferencing, co-authoring, sensor-based data collection, and process control--all of which involve MPC [Ref. 10].

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4 (U) SC21 N xxxx denotes an ISO working draft standard or technical paper distributed throughout SC21. Such drafts applicable to ATCCIS are listed at the end of the first section of Appendix E.

(U) ISO 7498 is being revised to incorporate the connectionless-mode text (AD1) into ISO 7498-1, *Basic Reference Model, General Aspects*. A working draft of the revised text [SC21 N 5092] was distributed in June 1990 [Ref. 11]. The ULA is still at the proposed draft stage in ISO.

(U) ISO 7498-1 is also being revised to permit routing and relaying between individual local networks to be performed in the Data Link layer. This work is being coordinated with CCITT [Ref. 12]. Other work includes clarifying the distinction between connectionless and connection-mode operation, aligning the service definitions for the lower layers and also for the upper layers, improving consistency of layer descriptions, adding Reset as a facility to the Data Link Layer, adding Suspend and Resume as functions in the Transport Layer, and aligning this work with CCITT. The first draft of the revised text for ISO 7498-1 is expected to proceed to CD ballot late in 1990 [Refs. 13, 14].

(U) The OSI Reference Model is being supplemented by a number of other models and frameworks within the context of OSI. These include Application Layer Structure, Internal Organization of the Network Layer, and the Transaction Processing Model [Ref. 15]. Conventions for specifying OSI service definitions are also being developed. CD text has been distributed in ISO [SC21 N 5101, June 1990] for a new standard, *Conventions for Service Definitions*, CD xxxx [Ref. 16]. The three parts are *General Model and Conventions, Application Layer*, and *Layers 1-6*.

4.2.2 Interworking of Layers in OSI

(U) The basic interworking standards used for specifying relays are the following (examples of relay profiles using these standards are given in Appendix B):

- DP 10028.2, *Definition of the Relaying Functions of a Network Layer Intermediate System*, Second Draft, June 1989
- TR 10029, *Operation of an X.25 Interworking Unit*, March 1989
- DP 10038, *Media Access Control (MAC) Sublayer Interconnection (MAC Bridging)*, October 1988.

(U) DTR 10172, *Network/Transport Protocol Interworking Specification* [SC6 N 5906, March 1990], addresses the inability of end systems operating in the CO network protocol (ISO 8208/8878 X.25) and CL network protocol (ISO 8473) to interwork with each other. A mediating device, called the Interworking Functional Unit (IFU), is defined to perform relaying and/or conversion of protocol data units (PDUs) from

one network protocol type to another. Three modes of operation are considered in DTR 10172:

- Network Layer Relay (NLR). In the NLR mode the IFU operation functions as a regular intermediate system. CL NLR operation is in accordance with ISO 8473 and CO NLR with ISO 10177 and ISO 10028.
- Passive Transport Layer Relay (PTLR). PTLR does not itself operate on the PDUs of transport connections, but passes transport PDUs received in network service data units from each end system transparently to the other end system.
- Active Transport Layer Relay (ATLR). ATLR provides an end-to-end transport service by operating a separate transport connection to each of the connected end systems and relaying data from one connection to the other.

Since the PTLR and ATLR modes of operation lie outside the scope of the OSI architecture, the technical report is not planned to be converted to an ISO standard.

(U) The following comment on CL-mode and CO-mode interworking was provided to SC21 following a February 1990 meeting of CCITT SG VII regarding the proposed update to the OSI Reference Model (ISO 7498-1) [Ref. 17]:

> The connectionless/connection-mode crossover rules currently proposed by ISO appeared, to many of the Q23/VII attendees at this meeting to be unacceptable for use in fully supporting connectionless-mode CCITT applications, due mainly to interconnectivity problems. Many of the attendees felt that, for "across-the-board" support of connectionless CCITT applications, within the lower layers, there is a need to have common (mandatorily provided) support required that would assure interconnectivity among all connectionless-mode OSI CCITT applications. It was unanimously agreed that the concept of attempting to solve such interconnection problems exclusively through introduction of any "transport relay" concept in CCITT Recommendations is totally unacceptable.

4.2.3 Application Layer Structure

(U) The Application Layer differs from the other layers of OSI in several respects. Entities in the Application Layer are made up of a collection of application service elements (ASEs), each of which is defined by a set of service and protocol standards. These ASEs are combined in various ways to form various types of Application Elements (AEs). The Application Layer, as the highest layer of OSI, does not provide connections within the Application Layer. As a result, relationships formed by the transfer of information between AE invocations in the Application Layer have special significance.

(U) Standards in the Application Layer define procedures for the support of distributed information processing. The Presentation Layer supports the Application Layer by providing facilities for representing information exchanged between AEs. The Session Layer provides the mechanisms that may be used for controlling interactions between AEs.

4.2.3.1 ISO Studies on Application Layer. (U) In its November 1989 Strategic Plan, JTC1 directed five initial major technical studies in order to address new or expanding areas to provide a basis for planning the JTC1 long-range programme. The studies of required standards are all applicable to the Applications Layer:

(1) Defining interfaces for application portability

(2) Defining interfaces required for distributed systems and applications

(3) Integrating voice, data, text, graphics, and image information at the user application level

(4) Addressing the area of artificial intelligence

(5) Supporting modelling of user requirements.

4.2.3.2 Application Layer Structure (ALS). (U) ISO 9545, *Application Layer Structure,* was published by ISO in December 1989. This was based on work done by SC21/WG6. ISO 9545 defines the nature of standards in the Application Layer and the relationships among them, the architectural framework in which individual OSI Application Layer protocols shall be developed, and the categories of identifiable objects that are necessary for the specification and operation of protocols. It also relates distributed information processing activities to the standards in the Applications Layer. Key concepts from the ALS are the following:

- Association (application association)--a cooperative relationship between two AE invocations for the purpose of communicating information and coordinating their joint operation. This relationship is formed by the exchange of application protocol control information using the Presentation Service.
- Application context--a set of rules shared in common by two SE invocations in order to enable their cooperative operation. The application context is an example of a shared conceptual schema.
- Single association object (SAO)--the collection of things in an AE invocation related to a single application association.

- Single association control function (SACF)--the component of a single association object that represents the use of those rules in the application cor xt concerning interactions among ASEs within a single application association.
- Multiple association control function (MACF)--a component of the AE invocation that coordinates the interactions among multiple associations within an AE invocation in order to provide a coordinated service.

(U) SC21 N 4118, PDTR xxxx, *Methodology and Guidelines for the Development of Application Layer Protocols,* November 1989, is being developed by SC21/WG6 to provide a discipline into the development of application protocol standards in order to generate precise specifications. It describes a step-by-step procedure for generating ASE definitions and protocol specifications.

4.2.3.3 Extended ALS. (U) Work on an extended ALS (XALS) model has begun. The purpose of XALS is to supplement ISO 9595 (*Application Layer Structure*) by providing a more complete framework for development of Application Layer protocol standards that use other Application Layer protocol standards. A central focus of XALS is extension of the architecture for use of multiple associations [Ref. 18].

(U) XALS is planned to provide a revised ALS model that is significantly richer in scope and descriptive capability than is provided in ISO 9545. As a result, it will provide more options for the specification of Application Layer standards. Examples of new features being proposed for the XALS are:

- Defining application service elements (ASEs), application service objects (ASOs), and control functions. An ASO is made up of one or more ASEs and/or ASOs, and a control function. A control function is the component of an ASO that controls the interactions among ASEs and/or ASOs within the containing ASO [Ref. 19].
- Providing guidance for ASE specifications in the areas of the reference model the ASE supports, the service definition, the abstract protocol definition, and the ASE environment requirements specification.
- Addressing peer-to-peer (application level) relationships as well as the established concept of application association, such as are used on MHS, TP, EDI, and Directory.
- Accommodating both peer-to-peer and client-server interaction styles. (ROSE supports both styles of interaction. X-Windows and DOAM use client-server styles, for which the terminal in the X-Window environment is the server, whereas the terminal in the DOAM model is the client.)

(U) An approach being considered for XALS for defining ASEs is that each ASE is a complete specification of a function, together with the application protocol

data units (APDUs) that support it. The APDUs are defined in one or more abstract syntax specifications within the ASE standard. The name of the specification is a parameter used when establishing a presentation connection, with each resulting transfer syntax assigned its own presentation context. Concurrent use of multiple ASEs would be accomplished by either APDU concatenation or embedding one APDU in another as user data. FTAM, CCR, VT, and ACSE fit this proposed model, but not Directory, ROSE, or RTSE. The Directory protocol, for example, is used in conjunction with ROSE to completely specify an abstract syntax--the relationship between Directory and ROSE is not one of APDU concatenation or user data embedding. Use of XALS would benefit work in RPC and other ASE areas [Ref. 20].

(U) Future work on XALS is expected to include the following:

- Peer-to-peer relationship (in addition to application associations) [Ref. 21]
- Recovery model, new work item (JTC1 N 764) approved June 1990 [Refs. 22, 23]
- Multi-level structures, new work item (JTC1 N 846) approved June 1990 [Ref. 24].

4.2.4 Distributed Applications

(U) Application Layer standards often define, at least partially, distributed applications. Examples are MHS, Directory, and FTAM; specifically, Directory contains a specification of a directory information tree (DIT) and its associated navigation rules. The nodes of the DIT for CCITT are envisioned to be distributed worldwide. Such standards contain elements that relate to features (and models) of distributed applications, in addition to features related to communications transfer. In this regard, these standards relate both to the ODP model and the ALS model.

(U) The following are examples of tasks being proposed in generic work on distributed applications [Refs. 25, 26]:

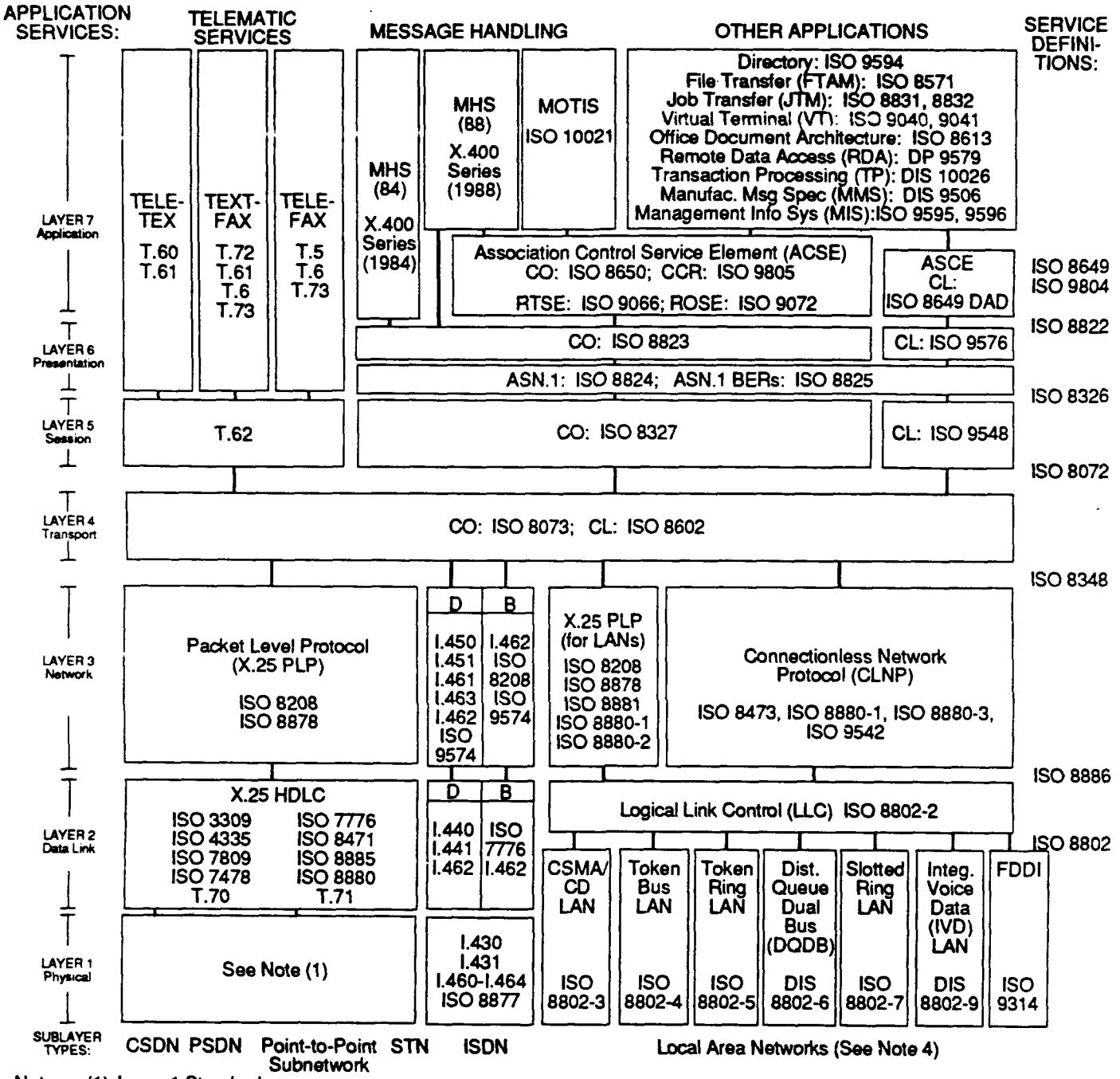
- Model information held by distributed applications and address issues of distribution and local transparency (the ODP work has chosen to recognize five different viewpoints from which various features of a distributed application can be modelled); *Modelling for Communications Aspects of Distributed Applications* has been accepted by JTC1 and assigned to SC21/WG6 [Ref. 27].
- Formalize management interactions between application processes in specific protocols in such functions as establishing relationships, distributing data, and replicating data.

- Devise global security mechanisms for use throughout the entire domain of the distributed application.
- Enable the schema for information held at an applications process to be distributed among cooperating systems.
- Address database issues such as data integrity and consistency, together with replication of data.
- Identify constraints on process decomposition and interaction types (communication among subprocesses).
- Specify support for configuration management, reconfiguration, and routing.
- Define application features to allow migration for future extensions.
- Address real-time effects associated with distribution.
- Provide for time synchronization of application processes.

(U) A key aspect of distributed applications that is essential to automated CCISs is that different components may have a different user view of the information held by the distributed application. Presentation Layer facilities generally require that there be full agreement between communicating systems at both the concrete (transfer syntax and data) level and the abstract syntax (close to information) level, thus requiring the components to have identical views of the information. The standards permit some capability for multiple user views, but such use of the standards could result in poor control of agreement and consistency between the components [Ref. 28].

4.3 Standards Activities and Emerging Standards

(U) This section begins with a description of the base standards that have been defined for the OSI seven-layer model. Stacks of base standards are described separately for application options, transport options, and relay options. This is followed by a description of two related sets of standards that are emerging--one for OSI management and one for directory services. Figure 9 provides an overview of the standards applicable to the TF. The layer OSI standards are connected by vertical lines to depict a wide range of stacks for application and transport options. OSI management, security, registration authorities, conformance testing, and other standards applicable to all the Basic Facilities are identified and discussed in Chapter 8. These are not included in Figure 9.



Notes: (1) Layer 1 Standards are:
(a) CSDN/PSDN: ISO 2110, 2593, 4902, 4903; V.24, V.28, V.35, V.36; X.21, X.21bis, X.22, X.24, X.26, X.27,
(b) Point-to-Point Subnetwork: Predefined
(c) STN: ISO 2110, 2593, 4902, V.10 or V.11, V.20, V.24, V.27, V.31bis, V.35, V.36, V.37, V....

(2) Standards are CCITT unless designated ISO, DIS, or DP.
(3) Stacks are based on 1989 *NTIS Transition Strategy*.
(4) Each LAN standard addresses both Layer 1 and Layer 2 (Media Access Control).

Figure 9. (U) Stacks of Standards for Application and Transport Options

(U) Examples of possible application and transport option are depicted in Figure 9. The types of transport services are identified along the bottom of the figure. Standards and options in a layer common to several stacks are shown in blocks. For example, the Logical Link Control (LLC) in Layer 2 is common to stacks for all types of LANs shown in Figure 9. Above the LLC, the CO-mode X.25 Packet Level Protocol (PLP, ISO 8208, 8878, 8880-1, 8880-2, and 8881), and the connectionless network protocol (CLNP) apply to each of the four LAN options. The X.25 PLP (ISO 8208 and 8878) in Layer 3 and the High-Level Data Link Control (HDLC) in Layer 2 are common to stacks for four types of circuits: Circuit Switched Data Network (CSDN), Packet Switched Data Network (PSDN), Point-to-Point Subnetwork, and Switched Telephone Network (STN).

4.3.1 Base Standards and Stacks of Base Standards

(U) This section identifies the OSI standards that are relevant to the TF. Table 1 (above) identified OSI options applicable to ATCCIS, which are, with the possible exception of VT and JTM, all relevant to the TF. The most useful form in which to present the specific standards that support OSI options is ordered groupings (called stacks) to show their application to specific interfaces and services. Tables 2, 3, and 4 identify stacks for application options, transport options, and relay options, respectively. The relationship among these three classes of options was described earlier in Figure 6. The stacks are taken primarily from the 1988 recommendations of TSGCEE SG9 for the *NTIS Transition Strategy* [Ref. 4]. (Appendix B provides figures that depict in more detail 4 application, 20 transport, and 11 relay functional profiles from the 1989 *NTIS Transition Strategy*.) The NATO profile reference used in the *NTIS Transition Strategy* is given in the first column of Tables 2, 3, and 4 (the symbol "ICT" identifies intercept recommendations that have no profile number). The standards include CCITT recommendations (e.g, T.60, X.402, V.24) and ISO standards.

(U) Of the possible sets of transport standards for LANs providing combinations of CO-mode and CL-mode transport and network services, CL transport with CO network service has not yet been included in Table 3. Standards for the case of asynchronous devices (start-stop transmission) are listed under Options in the second part of Table 3, although the relevant standards (X.28 and X.29) also control OSI layers above Layer 4.

Table 2. (U) Upper-Layer Stacks of Base Standards for Application Options

UNCLASSIFIED

NATO Profile	Application Option	Layer 5	Layer 6	Layer 7
A.1	File Transfer, Access and Management (FTAM)	ISO 8327 ISO 9548	ISO 8823 ISO 9576 ISO 8824-25	ISO 8571 ISO 8649 ISO 8650
A.2	Teletex	T.62	T.60 T.61	T.60 T.61
A.2	Textfax	T.62	T.72, T.61 T.6, T.73	T.72, T.61 T.6, T.73
A.2	Telefax	T.62	T.5, T.6 T.73	T.5, T.6 T.73
A.3[*]	Message Handling Service (MHS-88); MOTIS	ISO 8327 ISO 9548	ISO 8823 ISO 9576 ISO 8824-25	ISO 10021 ISO 9066 ISO 9072 ISO 8649 ISO 8650 X.403, X.408 T.330
A.4	Virtual Terminal (VT)	ISO 8327 ISO 9548	ISO 8823 ISO 9576 ISO 8824-25	ISO 9040 ISO 9041
A.5	Transaction Processing	ISO 8327 ISO 9548	ISO 8823 ISO 9576 ISO 8824-25	DIS 10026-1,2,3
A.6	Job Transfer and Manipulation (JTM)	ISO 8327 ISO 9548	ISO 8823 ISO 9576 ISO 8824-25	ISO 8831 ISO 8832
A.7	Remote Data Access	ISO 8327 ISO 9548	ISO 8823 ISO 9576 ISO 8824-25	DP 9579
A.8	Management Information System (MIS)	ISO 8327 ISO 9548	ISO 8823 ISO 9576 ISO 8824-25	ISO 9595 ISO 9596
A.9	Directory	ISO 8327 ISO 9548	ISO 8823 ISO 9576 ISO 8824-25	ISO 9594 X.500, X.501 X.509, X.511 X.518, X.519

Source: NTIS Transition Strategy, TSGCEE SG9, 20 June 1988, NATO UNCLASSIFIED.
*Note: Transition Strategy cites MMHS for NATO Profile A.3; most currently defined MMHS requirements appear to be in MHS-1988 (analysis by TSGCEE SG9 is not yet complete).

Table 3. (U) Lower-Layer Stacks of Base Standards for Transport Options

UNCLASSIFIED

NATO Profile	Transport Option	Layer 1	Layer 2	Layer 3	Layer 4
T.21	Permanent Analogue Circuit	V.24 V.35 V.36 ISO 2110.2 ISO 2593 ISO 4902.2	ISO 3309 ISO 4335 ISO 7478 ISO 7776 ISO 7809 ISO 8471 ISO 8885	ISO 8208 ISO 8878 -	ISO 8073 (Classes 0 & 2)
T.31	Permanent Access to PSDN: End System PSDN	X.21 ISO 4903.2	ISO 3309 ISO 4335 ISO 7478 ISO 7776 ISO 7809 ISO 8471 ISO 8885 X.25 X.25	ISO 8208 ISO 8878 X.25 X.25	ISO 8073 X.25
T.32	Permanent Digital Circuit	X.21,DIS 4903.2	ISO 7776	ISO 8208	ISO 8073
?	Switched Telephone Network (STN)	X.28	ISO 7776	ISO 8208	ISO 8073
T.41	Switched Digital Circuit (CSDN): (CCITT T.70 Type)	X.21	T.70 X.21	T.70 X.21	ISO 8073 (Class 0)
T.42	Switched Digital Circuit (CSDN): Call Control and Clearing Phase Data Transfer Phase	 X.21 X.21,ISO 4903.2	 X.21 ISO 7776	 X.21 ISO 8208	 N/A ISO 8073
T.61	LAN Providing CO Network Service and CO Transport Service	ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8802/2 ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8881 ISO 8878 ISO 8208	ISO 8073
T.62	LAN Providing CL Network Service and CO Transport Service	ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8802/2 ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8473	ISO 8073 (Class 4)
T.63	LAN Providing CL Network Service and CL Transport Service	ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8802/2 ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8473	ISO 8602
ICT	Asynchronous Devices (Start-Stop Transmission)	X.20	X.28, X.29	X.28, X.29	X.28, X.29
ICT	Integrated Services Digital Network (ISDN): D Service (16,000 b/s) B Service (64,000 b/s)	 I.430, I.431 I.460-463 ISO 8877 I.430, I.431 I.460-463 ISO 8877	 I.440, I.441 I.462 I.462	 I.450, I.451 I.460 I.462 T.70	 ISO 8073 ISO 8073

Source: NTIS Transition Strategy, TSGCEE SG9, 20 June 1988, NATO UNCLASSIFIED.
Note: ICT identifies a TSSGCEE SG9 intercept recommendation that is not part of the NATO profile taxonomy.
Note: ISDN standards have been changed in the 1988 CCITT recommendations; new numbers need to be identified and incorporated here and elsewhere. See Annex D and Annex E (Part II).

Table 4. (U) Stacks of Base Standards for Relay Options

UNCLASSIFIED

NATO Profile	Relay Option	Layer 1	Layer 2	Layer 3
R.12	LAN to WAN/PSDN to LAN:			
	LAN	ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8802/2 ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8473
	WAN/PSDN	X.21 ISO 4903	X.25 ISO 7776	X.25 ISO 8208
	Internetworking Service			ISO 8648
R.13	WAN/PSDN to WAN/PSDN	X.75	X.75	X.75
R.21	LAN to LAN:			
	LAN	ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8802/2 ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8473 ISO 8208
	Internetworking Service			ISO 8648
R.22	LAN to WAN/PSDN:			
	LAN	ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8802/2 ISO 8802/3 or 8802/4 or 8802/5 or 8802/7	ISO 8881
	WAN/PSDN	X.21 ISO 4903	X.25 ISO 7776	X.25 ISO 8208
	Internetworking Service			ISO 8648

Source: NTIS Transition Strategy, TSGCEE SG9, 10 June 1988, NATO UNCLASSIFIED.

4.3.2 MHS and MOTIS

4.3.2.1 Message Handling Standards. (U) Table 5 summarizes the set of standards that define MHS (CCITT X.400) and the Message-Oriented Text Interchange System (MOTIS ISO 10021) services. Efforts have been made by CCITT and ISO to converge MHS and MOTIS. The result, defined by standards released in 1988, is a substantially but not completely compatible set of new standards. [Balloting for the previous MOTIS standards (DIS 8505, DIS 8883, and DIS 9065) was suspended, and the scope of these standards has been incorporated in ISO 10021.] The relationship of the X.400-1984 (MHS-84), X.400-1988 (MHS-88), and MOTIS-1988 standards is provided in Table 5. Notice that MOTIS still has no parallel to the X.408 standards for algorithms used when converting between different types of encoded information, no parallel for the X.430 (now T.430) Teletex access protocols, and none for X.403.

(U) MHS-88 provides new (relative to MHS-84) capabilities for message store (listing, summary, fetching, and deletion of stored messages); security services (origin authentication, secure access management, data confidentiality, data integrity, nonrepudiation, and security management); distribution lists (members, submit permission, expansion point, and owner); directory services (authentication, name resolution, data list expansion, and capability assessment); physical delivery service (basic physical rendition, ordinary mail, physical forwarding, and return of undeliverable mail); and conformance testing (methods, criteria, and notation). In addition, MHS-88 revises MHS-84 standards for naming, addressing, routing, and special access.

4.3.2.2 Manufacturing Message Specification (MMS). (U) A Manufacturing Message Specification (MMS) has been defined. MMS is the key component of the Manufacturing Automation Protocol (MAP), the OSI protocol promoted worldwide by General Motors. The MMS work in ISO is under TC184/SC5/WG1, which is responsible for communications systems in the area of industrial automation [Ref. 29]. The MMS standard has two parts: DIS 9506-1 *(Service Definition)* and DIS 9506-2 *(Protocol Specification).*

4.3.2.3 MHS-1984 and MHS-1988 Profiles. (U) The standards for MHS-84 include delivery notification, disclosure of other recipients, explicit conversion (Message Transfer Service), grade of delivery selection, hold for delivery, prevention of non-delivery notification, probe, stored message alert, and stored message automatic forward.

Table 5. (U) Base Standards for Message Management

UNCLASSIFIED

CCITT X.400-LAYER	MHS CCITT X.400-1984	MHS MOTIS 1988	ISO-1988
7	X.400	X.400[a]	ISO 10021-1
7	X.401		
7	X.400	X.402	ISO 10021-2
7	N/A	X.403[b]	None
7	N/A	X.407	ISO 10021-3
7	X.408	X.408	None
7	X.409	X.208	ISO 8824
			ISO 8824 DAD1
		X.209	ISO 8825
			ISO 8825 DAD1
7	X.410	X.218	ISO 9066-1
		X.219	ISO 9072-1
		X.228	ISO 9066-2
		X.229	ISO 9072-2
7	X.411	X.411	ISO 10021-4
		X.419[c]	ISO 10021-6
7	N/A	X.413	ISO 10021-5
7	X.420	X.420	ISO 10021-7
7	X.430	T.330	None
7 (ACSE)	N/A	X.217	ISO 8649
		X.227	ISO 8650
6	N/A	X.216	ISO 8822
		X.226	ISO 8823

[a]1988 X.400 is double-numbered with 1988 F.400.
[b]Citation for 1988 X.403 includes three manuals.
[c]1988 X.419 and ISO 10021-6 have a wider scope than the part of 1984 X.411 and DIS 8883 that they replace.
Source: Provided by OMNICON on 8 September 1988.

(U) The 1988 CCITT X.400 recommendations are supplemented by a new series of standards on the service aspects of MHS. These standards are:

- F.400 System and Service Overview
- F.401 Naming and Addressing for Public Message Handling Services
- F.410 The Public Messaging Transfer Service
- F.415 Intercommunication with Public Physical Delivery Services
- F.420 The Public Interpersonal Messaging Service

- F.421 Intercommunication Between the IPM Service and the Telex Service
- F.422 Intercommunication Between the IPM Service and the Teletex Service.

(U) According to analyses conducted by WG2 of TSGCEE SG9, MHS-88 is not backward compatible with MHS-84 (due to changes in data type formats in the P1 protocol) and, even with a gateway between systems using different versions of MHS, there are several differences [Ref. 30] that could cause interoperability problems. For example, MHS-84 is unable to use the physical delivery capability of MHS-88. In addition, MHS-88 users may not be able to communicate with Telex terminals on an MHS-84 system. Finally, MHS-84 systems will reject some addresses that may be valid for MHS-88 systems. Addressing these problems without service request rejection will require a complex gateway. The incompatibilities of the MHS-84 and MHS-88 standards could present serious interoperability issues since ATCCIS or other ADP-supported CCISs might adopt the newer standard, but a variant of the older standard [*Standard Automated Message Interface for NATO ACCIS (STAMINA)*, described in Section 11.7] has been mandated for the ACE Automated Command and Control Information System (ACCIS) that supports battlefield command and control entities at echelons above corps. Note that while the 1989 *NTIS Transition Strategy* [Ref. 4] identifies the MMHS(84) as an intercept interoperability functional profile, the following caveat is included:

> It must be clearly stated that the MMHS-STANAG will be based on CCITT X.400 series version 1988, which offers a considerably enhanced functionality, including security services. Problems with backward compatibility can not be precluded.

(U) However, backwards compatibility of MHS-88 with MHS-84 is being claimed by many technical experts [Ref. 31-35]. According to Jim White [Ref. 35], CCITT Special Rapporteur for X.400, "backwards compatibility between 1984 and 1988 P1 has been achieved." P1 is the relay protocol from one Message Transfer Agent (MTA) to another. 1988 and 1984 products implementing P1 would be able to interwork because the 1988 P1 is a superset of the 1984 P1. However, the same is not true of the P3 protocol used for submission and delivery access for a remote User Agent. Specifically, it is not possible for a 1988 UA to use the P3 protocol to communicate with a 1984 messaging system. The rules that a 1988 system shall obey when interworking with 1984 systems are defined in Annex B, *Interworking with 1984 Systems*, of CCITT X.419.

4.3.3 File Transfer and Management (FTAM)

4.3.3.1 FTAM Standards. (U) FTAM defines a file service and specifies a file protocol within the Application Layer (Layer 7). The standard is concerned

with identifiable bodies of information that can be treated as files, which may be stored within open systems or passed between application processes. ISO 8571 defines the basic file service for FTAM. It provides sufficient facilities to support file transfer and establishes a framework for file access and file management. This standard does not specify the interfaces to a file transfer or access facility within the local system. An addenda may be added that reflects quality of service developments and integration. The FTAM standard currently has five parts and two addenda. An additional standard describes a performance test suite. The pertinent FTAM standards are:

- ISO 8571-1, Part 1: *General Introduction*
  - DAM1 Addendum 1: *Filestore Management*
  - PDAM2 Addendum 2: *Overlapped Access*
- ISO 8571-2, Part 2: *Virtual Filestore Definition*
  - DAM1 Addendum 1: *Filestore Management*
  - PDAM2 Addendum 2: *Overlapped Access*
- ISO 8571-3, Part 3: *File Service Definition*
  - DAM1 Addendum 1: *Filestore Management*
  - PDAM2 Addendum 2: *Overlapped Access*
- ISO 8571-4, Part 4: *File Protocol Specification*
  - DAM1 Addendum 1: *Filestore Management*
  - PDAM2 Addendum 2: *Overlapped Access*
- ISO 8571-5, Part 5: *PICS Proforma*
  - WDAM1 Addendum 1: *Filestore Management*
  - WDAM2 Addendum 2: *Overlapped Access*
- *Conformance Test Suite for the FTAM Protocol*
  - DIS 10170-1, Part 1: *Test Suite Structure and Test Purposes*, July 1990
  - WD 10170-2, Part 2: *FTAM Abstract Test Suite* (CD expected June 1991)
  - WD 10170-3, Part 3: *ACSE Abstract Test Suite Embedded Under FTAM* (CD expected June 1992)
  - WD 10170-4, Part 4: *Presentation Abstract Test Suite Embedded Under FTAM* (CD expected June 1992)
  - WD 10170-5, Part 5: *Session Abstract Test Suite Embedded Under FTAM* (CD expected June 1992)
- *Enhancement to FTAM Services to Satisfy Use Requirements*, January 1990 (CDAM expected June 1991)
- *Enhancements to FTAM Security Services*, July 1990 (CDAM expected January 1992).

(U) The current FTAM standard treats a filestore as an unstructured collection of files. Addendum 1 defines a structured filestore to allow the organization and manipulation of individual groups of files. Addendum 2 on Overlapped Access allows more efficient access to contents of a structured file. The Overlapped Access working draft specification uses the formal description language LOTOS. These extensions will support needs of the Network File Store, but harmonization with DTAM (CCITT) and DFR (SC18) will be needed. PICS proformas such as ISO 8571-5 are discussed in Section 8.4.

(U) A new work item on FTAM will provide for higher-level services using FTAM with other application services. Currently FTAM is not easily exportable to other application services. The new work will attempt to improve efficiency by reducing the number of confirmed requests (e.g., needed for file transfer over long-haul communications), extend and simplify FTAM services to allow other applications services (e.g, TP) to easily use FTAM services (e.g., for data transfer) with minimum overhead by providing high-level services, and to provide file services for other user services, such as CCITT telematic services.

(U) SC21/WG5 is developing a document type to enable FTAM to transfer CGM files as a structured file rather than (with current FTAM) as a transparent sequence of octets. The new work would provide access to the whole metafile, to the metafile descriptor, or to the individual pictures with an associated metafile descriptor. All three CGM encoding techniques would be supported: binary, clear text, and character text [Ref. 36].

(U) EWOS is developing a Remote Actions (RA) service and protocol for use with FTAM to support the ability to perform a remote action upon completion of a file operation. Examples of a remote action would be execution of a batch job that is transferred to another system via FTAM and to spool a print file to a printer after being transferred using FTAM. Both RPC and JTM could provide this support, but JTM is viewed in EWOS as too complex for simple remote actions. RA would not compete with JTM and specifically would not support such JTM services as gathering information for input to a job, spawning jobs to several systems, manipulating entries in job queues (e.g., kill a job), monitoring progress of jobs, or preparing progress reports [Ref. 37].

(U) The Joint European Standards Institution (CEN/CENELEC) has issued a draft European Prestandard (prENV), prENV 41 205, *Information Systems Interconnection - File Transfer Access and Management (FTAM) - File Management,* March 1989, for balloting.

4.3.3.2 Options and Profiles for FTAM. (U) Protocols and services for FTAM are specified in ISO 8571. The ISO standard (ISO 8571-2, Annex B) provides for three document types: unstructured text, sequential text, and unstructured binary. Stable Implementor's Workshop agreements have been published by the US National Institute of Standards and Technology (NIST) for four others: sequential file, random access file, indexed file, and file directory file. Six implementation profiles have been defined by the European Standards Promotion and Application Group (SPAG), which have the following corresponding profiles from the NIST OSI Implementor's Workshops:

- *Simple file transfer* (SPAG A/111, NIST T1)
- *Positional file transfer* (SPAG A/112, NIST T2)
- *Full file transfer* (SPAG A/113, NIST T3)
- *Simple file access* (SPAG A/122, NIST A1)
- *Full file access* (SPAG A/123, NIST A2)
- *Management* (SPAG A/13, NIST M1).

(U) An International Standardized Profile (ISP) is being developed by the JTC1 Special Group on Functional Standardization (SGFS) for FTAM [SGFS N 131, August 1989]. There are currently three parts:

(1) AFT nn - *File Transfer, Access, and Management* - Part 1: *Specification of ACSE, Presentation, and Session Protocols for the Use by FTAM*

(2) AFT nn - *File Transfer, Access, and Management* - Part 2: *Definition of Document Types, Constraint Sets, and Syntaxes*

(3) AFT nn - *File Transfer, Access, and Management* - Part 3: *AFT 11 - Simple File Transfer (Unstructured).*

4.3.4 Directory

(U) CCITT is developing a database application standard for logically storing directory information. The directory is a distributed database on users, processes, and other objects, used to provide access to information that people or processes require prior to communicating. The standards are in the following X.500 Series recommendations: X.500, X.501, X.509, X.511, X.518, X.519, X.520, and X.521.

4.3.4.1 Directory Services and Models. (U) The Directory services provide a specialized hierarchical database, called the Directory Information Tree, for OSI applications. The Directory contains information about objects and provides structured mechanisms for accessing that information. These services are intended to provide user friendly naming to permit a user to specify an object's name and then retrieve

additional addressing information. The two key aspects of the OSI Directory, which distinguish it from other database and name-server work, are [Ref. 38]:

- The Directory can be read, modified, and searched remotely via OSI protocols.
- A highly distributed database is provided by Directory System Agents (DSAs).

The following four models define the Directory services:

(1) The informational model describes the Directory Information Base (DIB). The DIB contains all the information to which the Directory provides access. This model is concerned only with the logical structuring of the information.

(2) The functional model describes interactions that take place between the various DSAs that comprise the Dictionary.

(3) The organizational model describes how portions of the Directory tree map onto the DSAs. This includes issues of replication and access control.

(4) The security model of Directory services describes the service in terms of authentication and authorization. ISO 9594-8, *OSI Directory Authentication Framework*, has now been transferred to SC21/WG1 (Security).

4.3.4.2 Directory Standards. (U) SC21/WG4 is working on OSI directories. ISO standards for the Directory are:

- ISO 9594-1, *Overview of Concepts, Models, and Service*, December 1988 [SC21 N 2751]
- ISO 9594-2, *Models*, December 1988 [SC21 N 2752]
- ISO 9594-3, *Abstract Service Definition*, December 1988 [SC21 N 2753]
- ISO 9594-4, *Procedures for Distributed Operations*, December 1988 [SC21 N 2754]
- ISO 9594-5, *Protocol Spe. .ications*, December 1988 [SC21 N 2755]
- ISO 9594-6, *Selected Attribute Types*, December 1988 [SC21 N 2756]
- ISO 9594-7, *Selected Object Classes*, December 1988 [SC21 N 2757]
- ISO 9594-8, *Authentication Framework*, December 1988 [SC21 N 2758]
- Amendments to Parts 2-5, *Access Control*, PDAMs, December 1989 [SC21 N 4041] (DIS text for June 1991, and IS status in June 1992)
- Amendments to Parts 2-5, *Replication and Knowledge Management*, PCDAMs, July 1990 [SC21 N 4913] (CD text planned for October 1990, DIS text for October 1991, and IS status in October 1992)
- Amendments to Parts 1-7, *Support of Nameform2* (WD text planned for June 1991, CD text planned for November 1991, DIS text for November 1992, and IS status in November 1993)

- Amendments to Parts 1-7, *Schema*, PCDAMs, July 1990 [SC21 N 4914] (CD text planned for October 1990, DIS text for October 1991, and IS status in October 1992)
- Amendments to Parts 3,4, *Enhanced Search*, PCDAMs, July 1990 [SC21 N 4924] (CD text planned for October 1990, DIS text for October 1991, and IS status in October 1992)
- WD 9594-9: *Directory Information Tree (DIT) Structure and Naming*, July 1990 (CD text planned for October 1990, DIS text for October 1991, and IS status in October 1992)
- WD 9594-10: *Replication and Knowledge Management*, July 1990 [SC21 N 4913] (CD text planned for October 1990, DIS text for October 1991, and IS status in October 1992)
- WD 9594-11: *Directory PICS Proforma*, July 1989 [SC21 N 4039] (new work item accepted by JTC1; a revised WD text is planned for June 1991, CD text for November 1991, DIS text for November 1992, and IS status in October 1993)
- *Test Suite for OSI Directory*, July 1990 [SC21 N 4951] (text recommended to JTC1 as a new work item)
- *Question on Standardization of Directory API*, July 1990 [SC21 N 4918] (recommended by SC21/WG4 for balloting within SC21).

4.3.4.3 Enhancement to Directory Standards. (U) CCITT SG VIII and SC21/WG4 are collaborating on enhancements to the Directory. Two areas being addressed are the Extended Information Model and Extended Search. The Extended Information Model work covers the generic way in which information is viewed in the Directory, from the viewpoint of both users and system administrators. The Extended Search work covers how extensions to the current searching mechanisms might be provided to offer a better service to the users of the Directory [Ref. 39].

(U) Extensions have been proposed to the DIT Structure Rule used to control the positioning of entries in the DIT based on the values of the Object Class attributes. The extensions would allow the subschema administrator to specify, within the portions of the DIB to which the subschema is applicable, criteria that allow the existence of entries based not only on the Object Class attributes of child entries and their parent entries, but also on the Object Class attributes of their other ancestor entries [Ref. 40].

(U) The concept of extensible matching rules is being developed in CCITT SG VII and SC21/WG4 for use in Directory and Enhanced Search. Capabilities such as approximate matching, diacritics-ignore matching, regular expressions, and word-sensitive searching are supported [Ref. 41].

(U) Work on a replication abstract service for the Directory is based on MHS abstract service definition conventions (ISO 10021-3). An underlying assumption is that the replication abstract service will be realized by means of ASEs. Data transfer systems, external to the DSA, may be needed to carry shadow updates. Replication operations are Request Shadow, Request Update, Refresh Shadow, and Terminate Shadow [Ref. 42].

(U) EDI users have requirements for use of Directory in which the naming structure would not necessarily be country oriented but would enable the current trading practices that use certain trading partner names [Ref. 43].

(U) CCITT and SC21 are considering the following features and facilities for joint work on Directory [Ref. 44]:

- Inverted directories for Telex and Teletex services
- Additional information with or after the result of a query
- Query cost information
- Information about services, service instructions, tariffs, etc., in standardized formats, taking into account additional attributes
- Additional service controls
- Full functionality of access control mechanisms
- Ability of the user to indicate the desire not to receive partial results when service control maximum parameters are exceeded
- Return of multiple responses in groups of any specified number
- Administrative procedures for authentication
- Standardized error service messages
- Shadowing (controlled replication) of Directory information
- Geographical extension
- Consequences of distributed Directory services.

4.3.4.4 Options for Directory. (U) Two international groups are working on functional standards (profiles) for the Directory. The issues being addressed by the NIST OSI Implementor's Workshop Directory Services SIG and the EWOS/ETSI Directory Expert Group indicate options within the Directory standard and areas where baseline standards may be exceeded to address practical implementation problems. Examples of the issues and options are:[5]

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5 (U) *Functional Standards for the X.500 Directory*, IST/21:1868, IST21/4/DIR, British Standards Institute, 4 October 1989.

- Classification of minimum schema capabilities.
- Classification of baseline structure rules--mandates the capability to access a standard Directory tree (which may be extended to a wide variety of entries).
- Definition of maximum APDU size--eases design of high-performance DSAs (e.g., to ensure the Directory can respond in seconds) and eases network problems in providing quality of service.
- Pragmatic constraints on filters--protects the Directory from pathological conditions and potentially simplifies design.
- Holes in distributed operation definitions--there are many undefined aspects for distributed operations (e.g., how to handle errors).
- Constraints on alphabets--Directory uses T.61 strings. Directory profiles are addressing rejection of strings that contain non-T.61 characters and restrictions on permissible characters (e.g., escape characters).
- Constraints on integer values--defines a minimum size integer that must be supported.
- Classification of authentication--mandate use of simple uncorroborated authentication that supports external authentication within a closed domain.
- Augmentation of attribute syntax rules--augments the standards material with practical rules.
- ASN.1 rules--mandates support of ASN.1 identifier tags that are three octets in length (and no longer) and requires constructed string elements not to be nested more than one deep.
- Strong authentication algorithms--proposing alternatives to the use of RSA™ (a licensed product) for digital signatures.

4.3.5 Application Service Elements

(U) The services performed in the Application Layer of the OSI model can be thought of as application processes whose communication aspects are represented by application entities. The OSI Application Layer structure permits an application process to have multiple communication aspects and, hence, multiple application entities.

(U) An application entity is a collection of one or more ASEs. Each of the peer application entities have identical ASEs. Additionally, each ASE talks only with its peer in the remote application entity. The remainder of this section discusses the ASEs:

- Association Control Service Element (ACSE), which provides association control and manages connections between application entities
- Commitment, Concurrency, and Recovery (CCR), which provides fault tolerance and manages error indication and recovery
- Reliable Transfer Service Element (RTSE), which manages bulk data transfers

- Remote Operations Service Element (ROSE), which manages request/reply interactions
- Remote Call Procedure (RPC).

(U) A typical application process might have a user element orchestrating the application entities' actions. This user element could use RTSE services to manage associations via ACSE services and could use the ROSE, which invokes RTSE services, to transfer data through the use of the presentation service.

4.3.5.1 Association Control Service Element (ACSE). (U) The ACSE provides service to both user elements and to specific application service elements. The purpose of this service is to support the establishment, maintenance, and termination of application associations. Because the ACSE manages the association of application entities, all OSI applications contain an ACSE. The services provided by ACSE are:

- ASSOCIATE, which sets up an application association
- RELEASE, which releases an association in an orderly fashion
- ABORT, which terminates application association simultaneously with the underlying presentation and session connections.

(U) The ISO definition of the service is technically aligned with the 1988 CCITT recommendation on the ACSE service. The differences between the ISO definition and the CCITT definition are quite small and are not expected to affect interoperability between implementations written against either document [Ref. 30]. There are four relevant ISO standards:

- ISO 8649, *Service Definition for the Association Control Service Element (ACSE)*
- ISO 8650, *Protocol Specification for the Association Control Service Element (ACSE)*
- ISO 10035, *Connectionless ACSE Protocol Specification*
- DIS 10169-1, *Conformance Test Suite for the ACSE Protocol,* Part 1: *Test Suite Structure and Test Purposes.*

(U) In addition, ISO 8650 and 8649 have three draft addenda: *Authentication, Connectionless ACSE Service,* and *A-Context Management Service.* Further, ISO 8650 has a fourth proposed addenda on *Application Entity Titles.* WD 10035-2 is the *PICS Proforma for Connectionless ACSE Protocol.*

4.3.5.2 Commitment, Concurrency, and Recovery (CCR). (U) The CCR service and protocol standards are used to supply a more fault tolerant association than is possible with ACSE. The ACSE has two basic flaws [Ref. 9]:

- A system crash leaves ambiguous results.
- A lack of coordination of multiple systems could produce inconsistent results.

These flaws are resolved in CCR by adding the concept of commitment. The master asks the subordinate for a commitment to perform a task (request) before the call for the execution of the task (commitment) is made. This allows for a record to be kept by both the master and the subordinate as to the status of the task.

(U) Recovery is the process of determining the status of a task after an application or communication failure. The CCR service provides partial support for recovery; however, the actual recovery process is specific to the application.

(U) Concurrency is a concept that is necessitated by the concept of commitment. Once an application entity has offered to commit, conflicting requests cannot be made against the application until the commitment is fulfilled. Concurrency is the mechanism by which committed resources are "frozen" until the committed application is completed.

(U) There are two standards relating to CCR, and each has three draft addenda: *Enhancements, Session Mapping Changes,* and *Restrart.* The ISO standards are:

- ISO 9804, *Service Definition for the Commitment, Concurrency, and Recovery Service Element*
- ISO 9805, *Protocol Specification for the Commitment, Concurrency, and Recovery Service Element.*

4.3.5.3 Reliable Transfer Service Element (RTSE). (U) RTSE provides a service of reliably moving arbitrarily large objects from one application entity to another. The RTSE accomplishes this service by dealing with ASN.1 data types rather than a string of octets and by abstracting the complexity of the underlying service session into an easily usable service.

(U) When an application context contains an RTSE, it is the sole user of ACSE services and the presentation service. The RTSE is used to signal to application elements that a transfer has been completed successfully The ISO standard for RTSE comes in two parts:

- ISO 9066-1, *Reliable Transfer,* Part 1: *Model and Service Definition*
- ISO 9066-2, *Reliable Transfer,* Part 2: *Protocol Specification.*

4.3.5.4 Remote Operations Service Element (ROSE). (U) Remote operations are a popular technique for building distributed applications. The ROSE manages operations for application entities via a mechanism that is analogous to services performed by CCR for data transfer. In its most primitive form, an operation is a simple request/reply interaction. The request, or invocation, consists of:

- An operation number--a unique identifier for the operation to be performed
- An arbitrarily complex argument--the "input" for the operation
- An invocation identifier--a unique identifier for a particular invocation
- A linked invocation identifier--an indication that this operation is being invoked as a part of the processing of another invocation.

(NU) An invocation can have one of three results:

- A result--an invocation identifier corresponding to the operation that succeeded and an arbitrarily complex result
- An error--an invocation identifier corresponding to the operation that failed, an error number uniquely identifying the error that occurred, and an arbitrarily complex parameter that provides clarifying information
- A rejection--an invocation identifier corresponding to the operation that was performed and a reason that describes the rejection that occurred.

(U) The standards that apply to the ROSE are:

- ISO 9072-1, *Remote Operations*, Part 1: *Model, Notation, and Service Definition*
- ISO 9072-2, *Remote Operations*, Part 2: *Protocol Specification.*

(U) ROSE is a set of communications facilities to distributed applications. ROSE was derived from the Remote Operations (RO) service defined in CCITT MHS-84. The standard (ISO 9072) also provides a notation for defining them (an extension of ANS.1). Remote operations service is asynchronous, so a client need not wait for a response before invoking another operation. ISO 9072 defines the structure of remote operations and the abstract services and protocol to support them. The services are generic in that their effect on the remote object is defined by their users.

(U) The basic interaction with a remote object is an operation that is similar to a procedure call in a programming language. An operation is invoked on a target object, to which the operation argument is passed. Operations have one of two possible structures, and invocations have two possible outcomes. Some operations return either a Result, when they are executed successfully, or an Error; other operations produce only a response (Error) if the operation fails.

4.3.5.5 Remote Calling Procedure (RPC). (U) The ECMA standard for RPC is ECMA 127. As defined in ECMA 127, an RPC is a communication service to transfer procedure calls to a remote server and return results, errors, or associated call backs. One of the central notions of RPC is that of a stub. A stub builds protocol information for RPCs (marshalling) and translates protocol information to server procedure calls (unmarshalling). ECMA 127 defines an Interface Definition Notation (IDN) to facilitate the transfer of data across an interface. The IDN supports a union of programming language-specific data types such as pointers, arrays, and records, and primitive data types such as integers and bit strings. ECMA 127 limits the number of outstanding procedure calls to one per association, in order to prevent livelock situations and preserve fairness; it is unclear if this is the most efficient solution to the livelock problem. SC21/WG6 proposes to address RPC using an IDN that is based on abstract data types rather than on a union of programming language-specific data types.

(U) Text for DIS 10148, *Basic Remote Procedure Call (RPC) Using OSI Remote Operations* [SC21 N 3463], was based on ECMA 127 and submitted in 1989 on a fast-track ballot, which has failed. DIS 10148 has now been withdrawn, and a September 1989 proposal for a new work item was accepted by JTC1 in May 1990. The planned schedule for RPC is to CD text in January 1991, DIS text in January 1992, and an international standard in January 1993 [Ref. 45].

(U) The aim of the current work in ISO on RPC is to provide a mechanism for writing distributed applications that are both syntactically and semantically similar to a local procedure call. The scope of RPC includes a language-independent IDN for specifying interfaces between components of distributed applications. The RPC protocol for a particular interface definition is derived from the IDN. RPC is closely related to two projects in SC22: Common Language Independent Data Types and Common Language Independent Procedure Call Mechanism. It is not at all clear whether remote operations (ISO 9072) can be used to satisfy RPC requirements or whether collaborative work with CCITT will be conducted for RPC [Ref. 46]. SC21/WG6 has identified requirements for RPC and IDN [Ref. 47] and has begun coordination of these requirements with SC22/WG11 and CCITT SG VII.

(U) ASN.1 may not be adequate as a basis for the IDN, even if extended for this purpose. Some requirements for the IDN identified in SC21/WG6 are [Ref. 48]:

- Be user friendly in the sense that an applications programmer can translate from the IDN to the programming language of choice in a straightforward, approximately one-to-one manner
- Be useable to automatically generate language-specific interfaces that support procedure calls using the RPC service
- Be useable to automatically generate the programming language-specific procedure declarations that correspond to the procedures in an IDN for use by a server.

(U) There would appear to be some danger of duplication of effort--and possibly even rival standards--unless RPC is brought together, in some manner, with ROSE [Ref. 49]. For example, ROSE has already standardized an IDN, called RO-notation, that uses ASN.1 as a language-independent way of describing the data types of the parameters. ROSE is already used widely, and a program of enhancements to allow it to meet additional needs is underway. However, ROSE is not even mentioned in the new RPC work item proposal.

4.3.6 Abstract Syntax and Basic Encoding Rules

4.3.6.1 Abstract Syntax Notation One (ASN.1). (U) At present, ASN.1 is the only abstract syntax language that exists in OSI. Abstract syntax languages describe data types in a machine-independent manner, thus freeing data representation from machine restrictions. For example, a protocol specifying that a data type is an integer need not concern itself with the number of bits required for the internal machine-dependent representation of this data type.

(U) ASN.1 has a rich syntax for describing data types and provides a macro facility for extending its grammar. According to Rose [Ref. 30],

> ASN.1 is destined to become the network programming language of the 90's, just as the C programming language is largely seen as having been the systems programming language of the 80's.

(U) The pertinent specifications for ASN.1 are ISO 8824, ISO 8824/DAM1, ISO 8824/WDAM2, and recommendation X.208 from CCITT. The ISO specifications are compatible with those of CCITT, but include a few extensions [Ref. 9].

(U) The Framework for the Support of Distributed Applications (DAF), a new activity established by CCITT SG VII to standardize common aspects of distributed applications, has been working for various enhancements to ASN.1. There are presently five working documents for possible extensions to ASN.1 in the 1992 time frame. The areas covered by these documents are [Ref. 50]:

- Provide a firmer framework for the specification of table types and functions
- Improve current definitions of character strings
- Provide new encoding rules, Packed Encoding Rules (PER), Confidential Encoding Rules (CER), and Distinguished Encoding Rules (DER), to supplement or replace the current Basic Encoding Rules (BER)
- Improve machine processability
- Provide miscellaneous enhancements.

4.3.6.2 Basic Encoding Rules (BER). (U) The mechanism that translates the abstract representation of data to its physical characteristics, either for machine storage or for transmittal, is called transfer syntax. The transfer syntax in OSI corresponding to the abstract syntax ASN.1 is contained in *Basic Encoding Rules*, ISO 8825.

(U) The BER use a "TLV" approach to mapping between abstract and physical data: each data type is encoded as a Tag, a Length, and a Value. The tag field corresponds to the label defined by the data type's abstract syntax, the length field normally indicates how many octets are used for the encoding of the value portion of the data type, and, finally, the value of the data type is encoded.

(U) The relevant standards for BER are ISO 8825, ISO 8825/DAD1, ISO 8825/DAD2, and CCITT X.209. Again, the ISO and the CCITT specifications are compatible.

4.3.7 Other Standards

4.3.7.1 TP and ODP. (U) The TF may make use of two services that may be seen as outside the OSI Reference Model: distributed TP and ODP. These services are primarily applicable to the DMF. The status of the standards defining them is described in Section 6.2.6 (TP) and Section 6.2.7 (ODP).

4.3.7.2 VT and JTM. (U) VT is specified in ISO 9040 (services) and ISO 9041 (protocols). JTM is specified in ISO 8831 (services) and ISO 8832 (protocols). Further analysis is needed to determine whether these features are applicable to the ATCCIS TF. The standards for these services are discussed in Chapter 9.

4.3.7.3 Time Synchronization. (U) CCITT SG VII(Q19) has begun work on a time synchronization service (TSS). The work is based on the US DoD RFC-1119, *Network Time Protocol (NTP)*, currently being used by the Internet community (see Section 4.3.7.5). The TSS time standard is based on the Coordinated Universal Time (UTC), determined by the Bureau International de l'Heure (BIH) from astronomical observations provided by the US Naval Observatory and other observatories.[6]

(U) The TSS can be used in distributed systems in several ways: to measure elapsed time, to preserve the order of events, and to coordinate activities of a set of processes. The elements of the TSS model are the following:

- Local clock--an oscillator that, once set with a time value, attempts to maintain a local estimate of global time
- Time user agent (TUA)--the user of the TSS
- Time synchronization agent (TSA)--the provider of the service.

(U) Each TUA interacts with a set of TSAs to obtain information, from this information to determine the best estimate of global time, and to set the local clock to this value. The TUA may adjust the frequency of the local clock to compensate for drift in the hardware. Synchronization of clocks is by continuous distribution of time--TUAs build up information based on samples of a number of servers for the delay characteristics of the communication path between itself and each of the TSAs.

(U) Time is distributed through the system via a hierarchical set of TSAs. Stratum 1 TSAs, at the top of the hierarchy, have local clocks that are set by external means from the most accurate sources available. These means could include radio receivers and such satellite devices as the Global Positioning System. Clocks that have been set by TUAs that have obtained time information directly from Stratum 1 TSAs are said to be at Stratum 2. At each level of the hierarchy, except the top and bottom, each TUA may have an associated TSA that can be used to distribute time information in the local clock to TUAs at the next lower level of the stratum. It is expected that there will be a number of Stratum 1 TSAs, some being provided as public services. Each site using LANs would have two or more Stratum 2 TSAs, and each LAN segment could have two or more Stratum 3 TSAs. Individual end systems might not need to have clocks at much more than Stratum 4 [Ref. 51].

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6 (U) Discussion on time synchronization was taken from SC21 N 4565, *Liaison Statement to SC21/WG4/WG7 on Time Synchronization*, CCITT SG VII, March 1990.

4.3.7.4 ECMA Model for Management. (U) In January 1987 the European Computer Manufacturers Association (ECMA) established [Ref. 52] an abstract model for the management aspects of OSI. The framework provided by ECMA is designed to form the basis for the definition and specification of services and protocols that enable the planning, organizing, supervising, and controlling of the communication service that forms a part of a distributed information processing system. In this context, OSI management is defined as the collection and interchange of information necessary for the management of those aspects of open systems that are relevant to Open Systems Interconnection. The abstract model addresses standardization in two areas:

- Semantics of the management information transferred or extracted from the management information base (where the structure of the information within the management information base is viewed as a local matter and not subject to management standardization)
- Services and associated protocols for the transfer of management information between open systems; this requires that both the syntax and semantics of the information transferred be specified.

ISO standards for OSI network management are being developed by SC21/WG4; they are discussed in Section 8.2.

4.3.7.5 US DoD Standards for Internetting Networks. (U) The US military has developed and widely implemented (e.g., in the Defense Data Network) unique protocols for Layers 3 and 4 that are not OSI conformant. These protocols will serve as a costandard for the US DoD until transition to OSI is complete. These protocols are identified since they will be implemented in the transition strategy for tactical data systems to be fielded in the 1990s by the US Army [Ref. 53]. Details are provided in Appendix C (Section 2.7). A connection-oriented transport service (CLNS) is provided by the Transmission Control Protocol (TCP), which provides end-to-end reliability, and a connectionless-mode network service is provided by the Internet Protocol (IP). The IP provides connectivity over diverse network technologies.

(U) Historically, TCP/IP arose to meet the need for reliable transmission of information over media that did not guarantee reliable, error-free delivery of information (e.g. Ethernet, Packet Radio, and Satellite). The Defense Advanced Research Projects Agency (DARPA) sponsored research into survivable multi-media packet networking in order to improve the only existing network, ARPANET. This research resulted in the US DoD sponsored Internet suite of protocols.

(U) TCP/IP corresponds to Layers 3-4 of the OSI model. In terms of network service, the closest comparison is between the connectionless network service

(CLNS) and the service offered by the IP. The services offered by the the OSI CO-mode TP4 and the TCP are similar, however, three major differences exist:

(1) The TCP service is stream-oriented, whereas the OSI transport service is packet-oriented.

(2) The TCP service offers a graceful release, whereas the OSI offers this release in the session service.

(3) The TCP has an urgent data facility, whereas the OSI has an expedited data service.

(U) The major emphasis of the Internet suite is on the connection of diverse network technologies (Layers 1-4). In addition, several applications for use in the Internet suite are available (see Appendix H; for a more complete listing see Reference 20):

- Simple Mail Transfer Protocol (SMTP)
- File Transfer Protocol (FTP)
- TELNET
- Domain Name System (DNS).

(U) These services are the analogs of MHS, FTAM, VT, and Directory, respectively. All of the Internet application protocols are rather simple. They offer a basic level of service and have a very narrow scope. The OSI applications are, in general, functionally more capable than the corresponding applications in the Internet suit [Ref. 30]. In fact, the US government, as well as manufacturers and users, endorse OSI rules at the upper layers while preserving the established TCP/IP networks for the transport of information [Ref. 54].

(U) The technical body that oversees the development of the Internet suite of protocols is termed the Internet Activity Board (IAB). The IAB is composed of senior researchers, the majority of whom are the designers and original implementors of the Internet suite. Any member of the Internet community can design, document, implement, and test a protocol for use in the Internet suite. The IAB requires that protocols be documented in the Request for Comments (RFCs) series.

(U) There are four RFCs that define the status of documents in the RFC series. The first is the *Assigned Numbers* [Ref. 55], which lists the assigned values used for the parameters in the Internet suite of protocols. The second is *Official Protocols*, which lists all official protocols. The third is *Gateway Requirements*, which lists all protocols and practices that relate to network nodes. And the fourth is *Host Requirements*, which lists all protocols and practices that relate to host nodes. These RFCs are periodically updated, with the most recent document always taking precedence.

4.3.7.6 ISO Development Environment (ISODE). (U) ISODE is non-proprietary software, developed as a tool to study OSI. In the current vacuum of OSI implementations, however, ISODE has become a default reference implementation of the OSI upper-layers, a platform for deploying OSI services, and a means for transitioning from TCP/IP to OSI protocols.

(U) The ISODE software supports various OSI protocols and applications. ISODE is aligned with US GOSIP. The current modules include the following [Ref. 30]:

- OSI transport service (TP0 on top of TCP, X.25, and the CO network service; TP4 for SunLink OSI)
- OSI session, presentation, and association control services
- ASN.1 abstract syntax/transfer notation tools
- OSI reliable transfer and remote operations services
- FTAM/FTP gateway
- OSI Directory services
- OSI VT (basic class and TELNET profile).

4.4 Assessment of Coverage by Standards

(U) MHS-88 provides a number of the military features identified by TSGCEE SG9 WG2 (Upper OSI Layers) for a Military Message Handling System (MMHS). Work on the draft STANAG for MMHS that was based on MHS-84 was completed as an intercept strategy, and analysis is now being performed in TSGCEE SG9/WG2 to identify additional features required for military application of MHS (See Section 10.3.8). Analysis of the relationship of MHS to ACP 129 and Abstract Syntax Notation One (ASN.1) to STANAG 5500 and other message standards is needed. NATO has requirements for media independent data communications protocols (e.g., for Link 1 replacement) that have not yet been developed; these standards could be applicable to the TF, and more work needs to be done in this area (see Section 10.3.4).

(U) Allied Communications Publication (ACP) 127 is a NATO standard for message handling services. In a comparison of the 65 service elements of ACP 127, a recent analysis [Ref. 56] has identified 55 as common to MHS-88. An additional five service elements were shown to be related to, but not the same as, those in ACP 127:

- Precedence levels (MHS-88 provides an Importance Indicator)
- Message identification (MHS-88 provides somewhat different features)
- Prosign C (MHS-88 has an obsoleting indication)

- Bell signal (MHS-88 provides a stored message alert)
- Date-time group (MHS-88 has a submission time stamp).

Five services provided in ACP 127 are not supported in MHS-88: financial accountability, service message, network continuity indication, off-line accountability, and tracer action. Version 4 of STAMINA provides MHS-84 services and ACP 127 functionality (see Section 11.7).

(U) A key feature required for the TF is the Directory service that may be fully addressed by CCITT X.500-1988 standards. Further analysis is needed of the features of, as well as the requirements for, Directory services.

(U) SC21/WG1 is still refining the OSI Reference Model regarding the specification of the boundaries of Layers 1 and 2. Some of the protocols needed for the TF may be determined to lie outside the Reference Model. These might include forward error correction coding (several ISO standards provide for error detection) and other mechanisms such as interleaving of bits from a sequence of octets to reduce the impact of the environment on certain transmission media. Protocols for handling requirements of cryptographic devices (e.g., synchronization) and media access may also lie outside the Reference Model. Standardization of these features within NATO should, wherever possible, be accomplished with media-independent STANAGs.

5. THE SERVICE CONTROL FACILITY (SCF)

5.1 Description of the SCF

(U) The SCF is defined in WP 24 [Ref. 3] as a logical entity that binds together all the facilities in a given ensemble, together with any National facilities that are supported by that ensemble. There is no concept of peer interactions between SCFs.

5.2 Standards to Support the SCF

(U) The selection of standards for the SCF is more difficult than for the TF for two reasons: (1) there are far fewer relevant international standards, and (2) the selection of standards for the SCF, more than for the other basic facilities, is nearly an implementation issue. The SCF appears to be outside the scope of the OSI model.

(U) In WP 24, Annex C, it is pointed out that one option for providing SCF functionality is through the selected operating system (possibly with some modifications). Potential operating system interfaces are described in the subsections that follow. Another option is to define a separate entity for the SCF; however, no standard appears to exist for such an entity, and the required services may be too ATCCIS specific to allow standards to be employed.

(U) Continued analysis of standards relevant to the SCF, including the consideration of options within specific standards, is dependent on the selection of base standards (e.g., a specific operating system). The PWG considers such a selection to be implementation dependent and wishes to leave open the possibility of other implementations that are presently less standardized (e.g., the use of a bare machine with an Ada run-time environment). Further analysis of potential SCF standards would be based on further definition of standard operating system functions and interfaces or refinement of SCF basic service requirements.

5.2.1 Portable Operating System Interface for Computer Environments (POSIX)

(U) The Portable Operating System Interface for Computer Environments (POSIX) is an interface standard for operating systems that is designed to be vendor independent and to promote application portability. Development of the POSIX standards is through the Institute of Electrical and Electronics Engineers (IEEE) Computer Society's Technical Committee on Operating Systems (TCOS). The TCOS has formed a large number of working groups. These working groups and the POSIX standards being

developed are identified by the same label, namely P1003 with an appropriate extension. The scope and status of the POSIX work in IEEE is provided in Table 6 [Ref. 57].

Table 6. (U) POSIX Standards Being Developed by the IEEE Computer Society, Technical Committee on Operating Systems for Submission to ISO Through ANSI

UNCLASSIFIED

P1003.1, *POSIX - System Interface and C Bindings*--defines a standard operating system interface and environment to support application portability at the source code level (approved by ANSI in November 1989 and by ISO as ISO 9945-1.

P1003.1a Provides editorial corrections that respond to concerns in balloting.

P1003.1b Adds functions and provides preparatory work for language-independent specifications. (IEEE balloting planned for late 1991.)

P1003.2, *Shell and Utilities*--defines a standard source-code-level interface to shell services and common utility programs for applications programs. (Draft #10 was submitted for IEEE ballot and to ISO as DP 9945-2.)

P1003.2a *User Portability Extensions.* (IEEE ballot planned for August 1990.)

P1003.3, *Test Methods: General*--defines general requirements and test methods for test suites to measure conformance of an implementation to IEEE POSIX and related standards; seeks to define what to test rather than how to test and promotes the development of testable standards. (Draft #11 was submitted to IEEE ballot in February 1990; approval of final text is expected late in 1990.)

P1003.3.1, *Test Methods: System Interfaces*--defines test methods and requirements for implementations of test suites to measure conformance of an operating system product to POSIX P1003.1. (IEEE ballot in February 1990; approval of final text expected late in 1990.)

P1003.3.2, *Test Methods: Shell and Utilities*--defines test methods and requirements for implementations of test suites to measure conformance of an operating system product to POSIX P1003.2. (IEEE balloting planned for early 1992; approval of final text expected late in 1992.)

P1003.4, *Real-Time Extensions*--defines a real-time extension to POSIX environments. (Balloting in May 1990; approval as an IEEE standard expected in the spring of 1991.)

P1003.4a, *Threads*--defines interfaces for handling multiple threads of control within a single POSIX P1003.1 process. (IEEE balloting planned for August 1990.)

P1003.4b, *Language-Independent Specifications*--rewrites interfaces defined in P1003.4 and P1003.4a into a language-independent binding. (Balloting planned for December 1990, with approval late in 1991.)

P1003.4c, *Extensions to P1003.4*--extends interfaces defined in P1003.1 and P1003.4 to include additional real-time facilities. (Balloting planned for 4Q 1991.)

P1003.5, *Ada Language Binding*--determines the Ada environment interface and Ada extensions required for POSIX; provides a specification for the Ada environment interfaces and Ada required extensions so that applications programs can be written to operate consistently on all conforming POSIX/Ada environments. (Balloting planned for August 1990 and approval of final text early in 1991.)

P1003.6, *Security Interface for POSIX*--develops specifications for standard interfaces to security services and mechanisms for portable applications to include Systems Call Interfaces and System Commands. (Balloting planned for May 1991 and approval in early 1992.)

P1003.7, *System Administration Interface*--defines a standard interface to utility programs for administering systems that conform to POSIX. (Balloting planned for 1Q 1992 and approval in 1993.)

Table 6. (U) (Continued)

UNCLASSIFIED

P1003.8, *Transparent File Access (TFA)*--develops system interfaces and other mechanisms to permit portability of applications into environments where files, directories, etc., may reside on remote systems. (Balloting planned for 2Q 1992.)

P1003.9, *FORTRAN Language Binding*--defines a FORTRAN-1977 language binding to applicable POSIX interfaces and functionality as specified in P1003.1,2,4, etc., and establishes an interface for FORTRAN to POSIX such that FORTRAN applications using POSIX functionality will be portable at the source code level. (Work based on results of /usr/group; balloting planned for August 1990.)

P1003.10, *Supercomputing Application Environment Profile (AEP)*--develops an AEP for supercomputing environments. (Balloting planned for 4Q 1990.)

P1003.11, *Transaction Processing AEP*--develops an AEP for transaction processing environments. (Balloting planned for Spring 1991.)

P1003.12, *Protocol Independent Interfaces*--defines programmatic interfaces that allow a portable application to communicate with another entity in the network such that the application may be independent of the underlying protocols. (Balloting planned for 1993.)

P1003.13, *Name Space/Directory Services*--provides a standard interface supporting the development of applications that use Directory services. (Status is uncertain; TCOS support withdrawn April 1990.)

P1003.14, *Real-Time AEP*--defines an AEP for real-time applications using the POSIX interfaces; addresses three profiles: full-function real-time system, embedded control system, and intermediate real-time system. (Balloting planned for early 1991.)

P1003.15, *Traditional Interactive Multiuser System AEP*--defines an AEP based on P1003 work and related standards that describes a traditional model of an interactive, multiuser system; establishes a profile to reflect traditionally understood functionality and addresses both application developers and users. (Status uncertain as work not yet approved by TCOS; balloting planned for mid-1991.)

P1003.16, *Multiprocessing Application Support AEP*--defines an AEP for multiprocessing applications environments based on relevant POSIX standards. (Balloting planned for mid-1991.)

P1003.17, *Batch Environment Amendments*--define utilities, library routines, system administration interfaces, and a host-to-host protocol to provide a network queueing and batch system in a POSIX environment. (Balloting planned for July 1991.)

Source: *Briefing on POSIX,* NIST, 12 June 1990, UNCLASSIFIED.

(U) The POSIX standard recently approved by IEEE was provided to ISO by the American National Standards Institute (ANSI). WG15 of SC22 within the JTC1 was formed in September 1987 and assigned responsibility for POSIX. The IEEE standard P1003.1[7] has been adopted as ISO 9945-1. WG15 eventually intends to remove the focus on UNIX and the C language to create a generic interface specification between any language and a multiuser environment.

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7 (U) P1003.1-1988 has been adopted as a US standard: Federal Information Processing Standard (FIPS) 151-1, March 1990. It is mandated for all US Government departments and agencies: "...shall be used ... where POSIX-like interfaces are required."

(U) Part 2 of the POSIX standard is for interfaces to shell and utilities (P1003.2). Draft #9 of IEEE P1003.2 has been submitted[8] to ISO through ANSI as DP 9945-2 and is currently undergoing a formal approval process. Part 3 will be *System Administration*. It has also established a project to describe POSIX by use of the Vienna Development Method-Specification Language (VDM-SL) as an FDT. All three regional workshops (AOW, EWOS, and NOIW) have accepted POSIX as part of their recommendations.

(U) ANSI is developing a standard interface for the C language (X3J11) that is compatible with POSIX. As shown in Table 6, IEEE is working on Ada and FORTRAN bindings for POSIX; the Ada binding should be complete in 1991. POSIX is intended to be compatible with both Database Language SQL and information resource dictionary system (IRDS) database management languages, as well as with OSI data communications and interprocess communications. Other aspects of POSIX standards work needed for the SCF are the security interface (1992), file access (1992), real-time extensions (late 1991), and protocol independent interface (1993) [Ref. 58].

5.3 Standards Activities and Emerging Standards

(U) Standards activities in areas related to the SCF have been primarily in the area of developing international, nonproprietary standards for interfaces to operating systems. It appears unlikely that an international standard for an operating system will be developed, in part because operating systems are closely tied to the hardware architecture of vendor products. International standards for entities other than operating systems that provide the SCF functionality have not appeared and no work is known in this area.

(U) As indicated earlier, POSIX is becoming a widely accepted approach to standardizing interfaces to operating systems; the initial standard for POSIX (ISO 9945-1) has been completed. Consortia have been formed to develop and promote profiles of standards that could be the basis for open environments and portable systems within these environments. All the consortia have adopted POSIX; however, there are differences in the approaches being taken. Activities of these consortia in the POSIX area are discussed in this section; additional information on portability profiles is provided in Chapter 8.

(U) The international nonprofit consortium X/Open™ is developing extensions to UNIX™ System V Interface Definition (SVID) to a distributed (two-phase) transaction processing environment that meets OSI standards A layered functional model for this

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[8] (U) P1003.2 (Draft #9, 1989) is currently undergoing a formal approval process as a FIPS for the US. Approval as a mandatory standard is expected early in 1991.

processing environment that meets OSI standards A layered functional model for this environment that consists of resource, commit, and transaction management has been proposed. This model requires certain extensions to the UNIX™ kernel (guaranteed output to files and concurrent input from peripherals). The X/Open System V Specification (XVS) is the initial recommended standard for the operating system. The extensions would be part of a Common Applications Environment (CAE), a concept to promote software portability. This would be achieved by adopting and adapting existing industry and *"de facto"* standards, rather than by creating a new standard. Future goals for the CAE are alignment with POSIX P1003.1 (with a large number of extensions) and ANSI X3J11 C together with interfaces for Indexed Sequential Access Method (ISAM) and an embedded standard Relational Database Language (SQL). The X/Open version of ISAM is based on a major (implementation nonspecific) subset of C-ISAM Version 2.10 (January 1985) from the Informix Corporation. The initial X/Open version of SQL is not fully compliant with ANSI X3.135-1986 [Ref. 59-61]. Standards recommended for the CAE are discussed in Section 9.4.3.

(U) Another approach to developing standard interfaces to UNIX-type systems is being taken by the Open Software Foundation (OSF), an international consortium formed in May 1988. The emerging operating system interface standards would initially be based on AIX™, an IBM version of UNIX interfaces. The operating system is planned to be fully compatible with the POSIX standards. In addition to the operating system, the other elements of the OSF architecture are: languages, user interface (e.g., distributed window manager), graphics libraries, networking services, and database management. Each element in the OSF Level Zero application environment specification is defined by existing ISO, FIPS, ANSI, and military standards. OSF is a non-profit, industry-supported research and development organization whose activities are designed to promote an open, portable application environment.

(U) A third approach to developing POSIX-conformant operating systems is underway. This approach is based on providing a version of the Berkeley UNIX with a POSIX interface.

(U) A fourth approach has been announced by the consortium called OPEN88. This consortium is reported to be planning to have a POSIX-conformant version of UNIX in 1990.

(U) The NIST has developed an Applications Portability Profile (APP) as an approach to identifying standards that could be used to achieve an open environment that would ensure a high degree of applications portability. In addition to the operating system, this environment includes data management, data interchange, network services, user

the key, in addition to open systems interconnection, to such an environment. NIST has identified [Ref. 62] a number of areas in which the current POSIX definition must be extended in order to "provide full operating system functionality." These extensions include shell and tools, system administration, and terminal interface extensions. Extended POSIX would be part of an integrated set of non-proprietary standards. Efforts are still required to specify the appropriate standards and "bindings" for the open environment. The complete APP proposed by NIST, together with the status of relevant standards other than POSIX, is discussed in Section 9.4.3.

5.4 Options Within the Standards

(U) POSIX standards are still in an early stage of development. Extensions to the draft standards currently available will increase functionality and reduce the options not yet addressed by the standards, specifically in the areas of language bindings, tools, and administration.

5.5 Assessment of Coverage by Standards

(U) While an operating system could provide SCF services, such services could potentially be provided in other ways. Standardization of operating systems appears unlikely and not required for ATCCIS. Further, there is no need to select a standard operating system for ATCCIS, since such a selection is viewed as an implementation issue left to the nations. When mature, adopting the POSIX interface standard for ATCCIS appears to be an attractive option, both to achieve some of the SCF functionality and to promote applications portability among the nations during implementation. Adoption of POSIX would probably not fully meet SCF requirements. However, further refinement of the SCF requirements and extension of the POSIX standard are needed to assess additional requirements for ATCCIS.

6. THE DATA MANAGEMENT FACILITY (DMF)

6.1 Description of the DMF

(U) The DMF for ATCCIS is defined in WP 24 as a logical entity in each ensemble that provides services for manipulating data objects to support the transfer of information between systems. The purpose of data management is to represent the meaning and relationships of the information items required to perform key tasks, to ensure meanings and relationships are preserved when information is exchanged with another ATCCIS system, and to ensure changes to data items in ATCCIS systems are applied consistently wherever these items are stored. The DMF provides the services related to transaction processing and database management, whereas the exchange mechanisms are provided by the Transfer Facility (TF).

(U) Peer interactions between two DMFs will be of two forms: either a DMF will be sending an update or it will be requesting data. One or more standard query languages will form the basis of the peer-to-peer protocol for the exchange of data between ATCCIS systems. More than one data model (e.g., relational, hierarchical, image/map oriented) may be required for the DMF. The information transfer services are primarily constrained by finite communications bandwidth and security. Security is discussed in Section 8.1.

(U) The DMF will provide mechanisms to accurately represent the meanings and relationships of the information items to be managed. These mechanisms include the database system, the conceptual schema, and ATCCIS domains. For each ATCCIS data model to be supported, these mechanisms will provide a standard way of representing the data, including support for common data definitions. (The definitions as well as the data would be standardized during the implementation phase of ATCCIS.) An example of one type of support that could be provided is a data dictionary system, which could be used by ATCCIS conformant systems to maintain common data definitions and representations. Another example is the data definition language (DDL) that may be provided with a database system or language. The DDL must be rich enough in its forms of expression to have attributes required of both commercial and military systems. For example, it needs to have the capability to recognize several types of hierarchy for data classification and compartmentalization and be trusted to permit access by users with varying levels of authorization for these classification levels and compartments.

6.1.1 Partitioned, Partially Replicated Database System

(U) As described in WP 24 [Ref. 3], Annex A, data transfer services in ATCCIS will be provided by a partitioned, partially replicated database system. Partitioning means that the entire ATCCIS database is segmented into disjoint parts that are held at geographically separate locations. Some of the parts of the ATCCIS database are copied or replicated at other locations to ensure survivability or to provide more rapid local access. A partitioned, partially replicated database provides sufficient flexibility for efficient exchange of information in a manner that minimizes usage of communication by permitting either "push" access (for updates) or "pull" access (for queries).

6.1.2 Conceptual Schema

(U) A common conceptual schema will define all ATCCIS data related to information exchange.[9] The ATCCIS database will be segmented or partitioned into replication domains, each owned and managed by a specified subfunctional area (SFA). Each replication domain has one master copy and may have other copies referred to as slave copies. A single DMF would be able to access some, but not all of the master and replication domains.

6.1.3 Domains

(U) Each domain comprises two parts. One part (domain details) provides the characteristics and control information for the domain. Examples of possible domain details are: name, owning SFA, home ATCCIS ensemble for the master domain, list of permitted users, component addresses for the replication domains, and security classification parameters. The other part of a domain (domain data) provides the values of each data item. The representations of some features of a domain, such as data item characteristics, data relationships, and data dictionaries, are implementation dependent and have therefore not been specified.

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9 (U) The schema may not identify information managed uniquely by a headquarters or a national system.

6.1.4 Required Services

(U) The DMF provides these basic services [Ref. 3, Annex A]:

- Data definition--provides a common understanding between systems on the attributes and meaning of data.
- Local queries--queries that can be satisfied by a data item or a set of items as specified in parameters supplied in the query, subject to authentication of the requestor's identity before issuing the data, such that the data resides in either a master or slave copy at the location where the query is made.
- Remote queries--transfers, from a remote master or slave copy, a data item or a set of items as specified in parameters supplied in the query, subject to authentication of the requestor's identity before issuing the data, from a location other than the one where the query originated.
- Consistency control--ensures that any updates to values of data items in a slave copy ultimately become the same as the values in the master copies of the relevant domain; consistency control also ensures that update transactions are applied in the correct order.
- Local updating--provides for changing the values of a data item or set of data items for a domain, where the master copy is held at the same location as the one where the update originated.
- Local slave updating--provides for changing the values of a data item or set of data items for a slave domain, but without replication of the updates.
- Remote updating--provides for changing the values of a data item or set of data items for a domain, where the master copy is at a remote location; these operations are subsequently directed to all slave copies of the relevant domain.
- Integrity of replicas--ensures that each replica, together with deferred updates, can be used to replace the master domain in the event of a system failure.
- Management of distribution--supports the partitioning and partial replication of the databases.
- Recovery from failure--provides mechanisms to decide that there has been a failure, allows recovery from failure, and permit a slave copy to become a master copy.
- Change of command--supports change of location of command (COLOC) and succession of command (SUCOC) by permitting a slave to become the master and by permitting new slave copies to be designated dynamically.
- Database statistics--provides status and usage data for the system manager.
- Database initialization--provides for the creation and loading of initial values of a database and its replicas when the system is initialized.

(U) In addition, the DMF will provide the following management services:

- Create domain--creates a new, empty domain, either as a master copy or for use as a replication copy of a domain.
- Delete domain--deletes a domain and erases all data in that domain. (When applied to a master copy it will delete all associated replication copies.)
- Transfer domain--causes, when proceeding to normal completion, the master of the domain to become a slave copy and the slave copy at a designated replication component to become the master.
- Assume domain--provides for change of ownership of a domain.
- Unassume domain--provides the capability to resolve the situation in which more than one ATCCIS component has exercised assumption of the same domain by designating another domain as the master.
- Amend domain--provides for changing the characteristics of a domain, such as the list of users or the replication list, by the owner or other authorized user.
- Details domain--provides for query of the details or characteristics of a domain by an authorized user.
- Copy domain--copies the entire contents of a domain, both characteristics and data, to a replication copy. (Space for the copy is first created by "create domain.")
- Restore domain--allows the owner of a domain to recreate the data in the master copy of the domain by copying it from a replication copy, in support of data recovery after failure.
- Advise domain--allows an ATCCIS component to be interrogated to see if it holds a copy of a domain. (This permits components who have lost and then reestablished communications to find out whether the replication list is correct.)

(U) Some options for standardizing the appropriate features of domains are inherent in the discussions in the sections that follow. Some services being evaluated to provide database operations (not yet adopted) imply implementation of a relational database architecture. Examples of database operations are: select, update, delete, insert, project, product, union, intersect, difference, divide, join, and equijoin.

6.2 Standards to Support the DMF

(U) This section primarily addresses the technical aspects of data management. The procedural aspects of data management are addressed in Sections 6.5 and 6.6. The Reference Model for Data Management described below applies to both the technical and procedural aspects.

6.2.1 ISO Reference Model for Data Management

(U) The Reference Model for Data Management is CD 10032. Development began in 1988 and a second CD text was distributed in 1990. The Reference Model for Data Management is expected to take 2 more years to complete. Issues to be resolved for this reference model include distributed operation and export-import concepts and requirements. Coordination with ODP is required.

(U) CD 10032 includes in the scope of data management the description, creation, modification, use, and control of data in information systems. The model provides a framework for identifying interfaces; positioning interfaces relative to each other; identifying facilities provided at each interface; identifying the process that supports each interface and, where appropriate, the specific data required for this support; positioning the use of the interfaces in terms of the information system's life cycle; and identifying the binding alternatives associated with each interface. The concepts defined in the model may be used to define the services provided by particular database management systems or data dictionary systems. The data management field of application concerns any user--human or applications program--who wants to request services for management and storage of information in a persistent manner.

(U) SC21/WG3 is preparing a technical report, *Tutorial for Reference Model of Data Management*, that will address the following topics [Ref. 63]:

- Tutorial aspects for the Reference Model of Data Management
- Analysis of current database standards in terms of the Reference Model concepts
- Analysis of data management services using data flow diagrams
- Description of current database standards with respect to the requirements of the Reference Model.

6.2.2 Data Definition and Manipulation Language Standards

(U) There are now two data manipulation language standards approved by ISO, ANSI, and FIPS: NDL[10] and SQL.[11]

6.2.2.1 Database Language NDL. (U) Database Language NDL (ISO 8907, ANSI X3.133-1986, FIPS 126) is an outgrowth of 1978 CODASYL

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[10] (U) NDL is not an acronym; historically, the term derived from the concept of a network data language.

[11] (U) SQL is also not an acronym; historically, the term derived from the concept of a structured query language, but today represents much more.

specifications using a network model for a DDL and a data manipulation language (DML). NDL is characterized, in part, by extensive use of logical pointers These pointers support such facilities as FIND NEXT (push down in a stack) and FIND OWNER (pop up in a stack). The specification work was conducted from 1981 to 1986 by the ANSI X3H2 Database Committee. No follow-on standards activities are being conducted by ISO or ANSI for NDL [Ref. 64, 65].

6.2.2.2 Database Language SQL. (U) SQL (ISO 9075, ANSI X3.135-1986, FIPS 127) is based on a relational database model; the specification work was conducted from 1982 to 1986 by the ANSI X3H2 Database Committee. Future work in the standards for database management systems by ISO and ANSI/X3H2 will be on distributed database processing (e.g., remote data access protocol) and extensions to SQL.

(U) Both ISO and ANSI are working closely together and in parallel on SQL2 (CD 9075.2), a follow-on standard. A draft proposal version of the SQL2 standard was released in 1989. SC21 has recommended that SQL2 proceed to a second CD ballot in July 1990. Due to the length of the document, 5 months has been allowed for comments. An editing meeting is planned for January 1991, IS text is expected in 1992. SQL2 is expected to incorporate the following draft addenda:

- Addendum 1 (ISO 9075 AD1, *Integrity Enhancement Feature*) provides for check clauses, default clauses, and referential integrity constraints.
- Addendum 2 (SC21 N 2663) would formally incorporate the appendix in ISO 9075 on embedded SQL for COBOL, FORTRAN, PL/1, and Pascal as a standard. Further, it would extend standards for embedded SQL to two more programming languages, Ada and C.

(U) Work has already begun on SQL3 (WD 9075.3), which is planned to become a standard about 1993. SQL3 would contain the following features:

- Generalized triggers (similar to IF...THEN statements; based on a condition of data, not time)
- Generalized assertions (given a certain condition, to trigger integrity checks on the database; e.g., to do before and after validation on values in the database)
- Recursive expressions (these allow an open-ended subordinate assertion, e.g., to completely search a tree--currently, only finite queries to specified levels are permitted)
- Escape from SQL to call external features
- Basic capability for user-defined data types (the only structure in SQL is a table; this allows the user to declare a domain separate from a table)

- Support for subtables, provided through inheritance and generalization features
- Appropriate support tools for object-oriented and knowledge-based systems.

6.2.3 Standards for Interfacing Data Definition and Manipulation Languages to OSI Service Elements

6.2.3.1 Remote Data Access (RDA). (U) RDA[12] is an ISO standard to facilitate access to databases from intelligent workstations and from other database systems. It is essentially a (standard) generalization of certain operations of database systems, file servers, and document servers. RDA will allow, with minimum of technical agreement outside the interconnection standards, the interconnection of applications and database systems from different manufacturers, under different managements, of different levels of complexity, and exploiting different technologies. Since an application may itself be a database system, RDA can be used to support multi-database system interworking.

(U) RDA service is designed to provide all possible valid data manipulation functions on any database. The functions needed (and available) depend on the structure and content of the database, so the definition of these functions must be accomplished at run time (not explicitly coded into software). Thus, RDA allows data management language operations to be defined and named (actually numbered) so they can be repeatedly invoked later in an application and association.

(U) The ISO standard for RDA (DP 9579) defines the format and meaning of messages that support this application. RDA uses common OSI services for the association control service element (ACSE)--ISO 8649 and ISO 8650, commitment concurrency and recovery (CCR) service elements--ISO 9804 and ISO 9805, and ROSE (ISO 9072) to provide the communications services. RDA can be viewed as a composition of ACSE and CCR with a specialization of the ROSE.[13] RDA needs no specific protocol of its own; it only requires additional sequencing rules and a method for handling violations of them. The Abstract Syntax Notation standards (ISO 8824 and 8825) are used in the Presentation Layer to define structures (data types) and rules for encoding structures so that the structures can be transmitted.

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12 (U) Discussion taken from *Remote Database Access*, Tutorial, SC21 N 1927, ISO/TC97/SC21, 28 July 1987, UNCLASSIFIED; and DP 9579-1, 29 March 1990 [SC21 N 4282].

13 (U) Application Service Elements ACSE, CCR, RTSE, and ROSE are discussed in Section 4.3.5.

(U) The ISO standard DP 9579 is based on work of the ECMA Technical Committee on Databases, CCITT, and ISO SC18. ECMA TR30 (December 1985) was the starting point for RDA, and ECMA TR31 initially defined the concepts, notation, and connection-oriented mappings for remote operations. DP 9579 has two parts:

- DP 9579-1, *Generic Model, Service, and Protocol* [SC21 N 4282, March 1990]
- DP 9579-2.1, *SQL Specialization* [SC21 N 4282, March 1990].

(U) The remote operations philosophy is based on object modelling in which the functionality of an object is modelled as a set of operations available at its interface. Object modelling also includes the notion of object classes, subclasses, and property inheritance. In RDA these concepts are used to define a generic RDA, which defines a class of remote database access applications, and specific RDAs, each of which defines a subclass of RDA applications. Those properties common to all RDA applications are defined in the generic RDA. Those that relate to subclasses are defined in RDA specializations.

(U) The generic RDA can support any data management language. One of the specific RDAs is a specification for the Database Language SQL [Ref. 66]. Other specific RDAs to be developed in the near future are also expected to be based on the relational approach. The relationship data management language was chosen because it supports complex selection functions and multi-record operations for updating and deletion. This enables the RDA to accomplish selection processing in the database server (the place where the data is stored). This reduces the amount of unneeded data that is transferred to the client (user) and thus minimizes use of communications [Ref. 67].

(U) The generic RDA standard has completed its first DP ballot. Alignment with the Application Layer Structure (ISO 9545) and TP (DIS 10026) is required. SQL1 (DP 9579-2.1) and SQL2 (WD 9579-2.2) specializations for RDA are being developed; a CD draft of the SQL2 specialization is expected in June 1991.

(U) The SQL1 specialization (DP 9579-2.1) defines the service and protocol for access to databases and supports the data manipulation functions of SQL. This is done through specifying the transfer syntax for specific data manipulation functions, as provided for in ISO 9075 for SQL database systems. The elements of the SQL (or any other) specialization are definitions for [Ref. 68]:

- Data resources available as a result of establishing a dialogue and any constraints on opening and closing further data resources
- Data structure of a class of data objects supported

- Permissible classes of operations upon the objects
- Representation of all operations in an abstract syntax
- Representation for data passed as parameters for these operations.

(U) The SQL specialization for RDA (DP 9579-2.1) augments the generic RDA (DP 9579-1) so that the two parts together define the following:

- Capabilities of an SQL database server that supports dialogues with clients
- Model of dialogues between the SQL database server and remote users
- Model of a dialogue between an RDA client and an SQL server
- Abstract service interface for the RDA SQL ASE that models the communications facilities supporting interaction between the SQL client and the SQL server
- RDA SQL ASE protocol to support the RDA SQL service
- Characteristics of application contexts that include the RDA SQL ASE
- Application contexts that support remote database access using SQL, specifically the RDA Basic Application Context and the RDA TP Application Context.

(U) SC21/WG3 is considering standardizing some or all of the following properties of distributed database systems [Ref. 69]--the new work would be done in conjunction with RDA:

- Single database image presented to the user
- Location transparency (includes automatic routing and transaction decomposition)
- Distributed transaction management
- Query optimization (to minimize communications flows)
- Data replication (optional)
- Local autonomy for database administration (i.e., no requirement for a single DBMS)
- Decentralized schema management
- Distributed deadlock detection/avoidance
- Extensibility (heterogeneous database)
- Concurrency management.

6.2.3.2 Remote Operations Service Element (ROSE). (U) ROSE standards are discussed with the TF in Section 4.3.5.4. The RDA service and protocol are defined using the Remote Operations (RO) notation of ROSE (ISO 9072-1). The RO notation is syntactically an extension of ASN.1 (ISO 8824).

6.2.3.3 Commitment Control, Concurrency Control, and Recovery Control (CCR). (U) CCR is architecturally part of the set of the Application Service Elements (ASEs) provided in the Application Layer (Layer 7). CCR (discussed in Section 4.3.5.2) supports distributed applications by defining service primitives for commencing and concluding protocol exchanges and related activity on each interconnection so that the entire sequence appears to other applications as atomic. CCR requires the cooperating application entities to organize their activity into a tree structure, either statically or dynamically defined. Commitment control uses a two-phase commit in which there is a phase to determine whether all the subordinates are prepared to carry out an atomic action (i.e., commit to the action) and a separate phase in which the subordinates are ordered to commit or roll back.

(U) Extensions to CCR being considered (amendments to ISO 9804 and 9805) include dynamic commitment tree, transfer of commitment decision to last subordinate (last subordinate optimization), real only optimization, heuristics, checkpointing (resumption after failure), return of rollback data, and negotiation of CCR facilities.

6.2.4 Information Resource Dictionary System (IRDS) Standards[14]

(U) An IRDS is a system that provides facilities for creating, maintaining, and accessing an Information Resource Dictionary (IRD) and its IRD definition. The IRDS framework standard (ISO 10027, May 1990) provides a common basis for developing information resource dictionaries (IRDs), which are sharable repositories for the definition of the information resources relevant to all or part of an enterprise. Information resources may include:

- Data needed by the enterprise
- Computerized and possibly noncomputerized processes that are available for presenting and maintaining such data
- Available physical hardware environment on which such data can be represented
- Organization of human and physical resources that can make use of the information
- Human resources responsible for generating that information.

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14 (U) Portions of the discussion of IRDS are taken from ISO 10027, *IRDS Framework*.

(U) The IRDS standard does not provide a standard definition of all the above kinds of information. Rather, it provides a framework for defining such information in which the information can be represented and managed. The content of an IRD can be compared with the content of a typical application database--an application database contains data of relevance to the day-to-day operation of an enterprise. The difference is that the data is at a higher level (metadata or data about data) and may include such entities as data item types, data files, computer programs, and subsystems.

(U) An IRDS is used to control and document an enterprise's information resources. ISO 10027, *IRDS Framework,* defines a number of concepts that are basic to data management. A *database* is a collection of interrelated data stored together with controlled redundancy according to a schema to serve one or more applications. *Database integrity* is the consistency of a collection of data in a database. *Export* is the function of extracting information from an IRDS and packaging it to an export/import file. *Import* is the function of receiving data from an export/import file into an IRDS. An *IRD* is a part of a repository managed by an IRDS in which the information resources of an enterprise may be recorded. A *value* is an abstraction with a single characteristic that can be compared with other values and that may be represented by an encoding of the value. A *data modelling facility* is a set of data structuring rules and an associated set of data manipulation rules. An *application schema* is a set of definitions that control what may exist at any time in an application.

(U) The IRDS Framework identifies the kinds of data, together with the major processors and their associated interfaces and the broad nature of the services provided at each interface. Aspects addressed by various IRDS standards include programming language dependence, interface style, data modelling facility used, and data interchange format. Examples of processor interface styles are programmatic (such as a procedure call interface, consisting of a sequenced set of parameters and associated binding rules for the CALL statement in a programming language); syntax for execution time interpretation; and service convention (a standard set of programming language independent conventions for specifying parameter lists and service primitives for use in an open systems environment). Examples of alternative styles for human interfaces are panels (abstract screen formats), concrete syntax (such as a command language), and graphics.

(U) An abstract syntax is the specification of a service (such as for an interface style) by using notation rules that are independent of the encoding techniques used to represent them. An abstract syntax may be used to define a set of services without prescribing any linguistic form to be used when each service is initiated or invoked.

(U) Examples of data modelling facilities are those based on standard database languages such as NDL or SQL, based on a non-standard database language, specific to a standard programming language (such as COBOL or PL/1), specific to a non-language standard (such as OSI Directory services), or which are non-standard data modelling facilities (such as entity-relationship modelling). Each data modelling facility is an intrinsically independent means of representing data and possibly the services that may be specified for such data.

(U) Three types of support can be provided for a database using international standards. One is using standardized services at an interface, in which the contents of some part of the IRD are defined, together with the services by which those contents may be accessed and manipulated. The second type of support is by standardizing in precise terms the content of some part of an IRD according to some prescribed data modelling facility. The services that may be performed on that data may or may not be implicit in the general data manipulation services associated with that data modelling facility. The third type of support is the use of a standard data interchange format, designed to facilitate the interoperability of several real systems by standardizing the formats of the various kinds of messages sent from one real system to another. A data interchange format may be specific to an application.

(U) IRDS provides for two types of user interfaces: a menu-driven (panel) interface and a command language interface. The panel interface provides for a structured path of screens (i.e., panels) by which an inexperienced user can execute IRDS functions. The command language may be used in either an interactive or batch mode. One of the facilities provided in IRDS supports the moving of data from one standard dictionary to another.

(U) IRDS, including the command language and panel interfaces, is specified in terms of entities, relationships, and attributes. The entities represent or describe the concepts and data objects about which values are to be stored in the database. Relationships are binary associations between two entities (e.g., one contains the other). Attributes represent the properties of an entity or relationship. Each relationship and attribute is assigned a specific type. Entities can be compared if they have a common attribute with a common type. Ordered sets of attributes, called attribute groups, are also provided in IRDS. The IRDS schema that defines and controls what is permitted in a data dictionary is also defined using entities, relationships, attributes, and attribute groups. IRDS supports local and universal naming conventions through three types of entity names: access names (used with the command language), descriptive names (e.g., from an ATCCIS-wide data dictionary), and alternate names (e.g., aliases used for the convenience

of one or more nations or one or more ATCCIS components). IRDS functions include adding, deleting, modifying, and copying entities and relationships, in addition to report writing.

(U) The IRDS is a data dictionary standard being developed in parallel by both ISO (JTC1 SC21/WG3) and ANSI (X3H4). The standard is based on the entity-relationship model and would be applicable to Database Language NDL and Database Language SQL. In addition to the ISO framework standard (ISO 10027), there is an ISO proposal for a *Command Language and Panel Interface* (DP 8800-1, March 1987). The project for DP 8800 has been suspended until the *IRDS Service Interface* (WD xxxx) reaches DIS status. The command language and panel interface are expected to be split into separate standards. Working drafts have been prepared in two other areas: *IRDS Design Support for SQL Applications* and *IRDS Export/Import*. CD texts for both these standards are expected in December 1991. The ANSI draft standard is identified as X3.138-1988.

(U) Unfortunately, the ANSI and ISO communities have diverged over the issue of whether relationships are permitted to have attributes (ANSI) or not (OSI). The rationale for the simpler model (no attributes) is that it would fit more easily with SQL tables. The rationale for the ANSI position is that a model permitting attributes, while more complex and more cumbersome, would provide greater flexibility. Further, a lot of existing products would be invalidated if no attributes were permitted for the relationships. A decision has recently been made by ISO that the IRDS Services standard should make use of the SQL data model and be defined in SQL terms [Ref. 70]. While this revision brings together two major database standardization activities, it further complicates the alignment of the ANSI and ISO standards.

(U) In WG3, development of the IRDS framework document is continuing and may require alignment of concepts with those of the Reference Model, which could take 2 years to complete. Ongoing work includes the *Services Interface* (scheduled for completion in 1991), *Export/Import* (scheduled for completion in 1993), *Support for SQL1 with Integrity Enhancement* (scheduled for completion in 1993), and two pending areas, *Command Language and Panel Interface*.

(U) Meanwhile, the US standards effort is building on the ANSI and FIPS IRDS. Three efforts are nearing US public review status, while five new work areas have been initiated. All of the new work is scheduled to be completed by early 1991. The three efforts that are nearing external review status are:[15]

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15 (U) Personal communication with Jerry Winkler, Chair, ANSI X3H4 on IRDS standards, June 1990, UNCLASSIFIED.

- *IRDS Services Interface (IRDS/SI).* The ANSI draft proposal for IRDS/SI began its initial US public review in the summer of 1989. The target date for an ANSI standard for IRDS/SI is early 1991.
- *IRDS Export/Import File Format.* The ANSI draft proposal for IRDS Export-Import File Format, which supports the export-import requirements identified in the X3.138, was released for public review in late 1989 and should be an ANSI standard by late 1990.
- *Technical Report on the IRDS Reference Model.* This report will explain the relationship of the IRDS within the information environment of an enterprise. This document is expected to be released in 1990.

(U) The other five efforts are: (1) *IRDS Naming Convention Verification,* (2) *Technical Report on the Requirements for an IRDS in a Distributed Heterogeneous Environment,* (3) *Technical Report on Integration of IRDS Schemas,* (4) *Standard on Export/Import Extensions,* and (5) *Technical Report for IRDS in a Distributed Environment.*

6.2.5 Conceptual Data Modelling Facility Standards

6.2.5.1 Conceptual Schema. (U) SC21/WG3 has identified five different uses of the term "conceptual schema." The following identifies the five uses and provides WG3 comments on those uses [Ref. 71]:

(1) The results of an analysis of the data and possibly the processes perceivable in some real-world situation.
   - There is considerable disparity among the data analysis techniques used in various parts of the world. Some are being energetically promoted by minority groups.
   - There are rapid developments in Computer Aided Software Engineering.
   - Attempts to standardize on any one technique may be premature. Such efforts should await availability of the Reference Model or Information Systems Engineering being developed by SC7/WG4.
   - Work on a conceptual data modelling facility should be considered as content of an IRDS and be conducted in accordance with the IRDS Framework (ISO 10027).

(2) A repository of "metadata" in which it is possible to specify declaratively 100% of the semantics of the data in a computerized information system (the 100% principle of TR 9007).
   - The 100% principle has had major influence on SC21/WG3 work in the development of SQL. The SQL draft proposal being progressed contains language specifications that make it possible to specify declaratively a very large percentage of the constraints on the data that a database designer is ever likely to want to define.

- While SQL is never promoted as a means of defining a conceptual schema, it is, in this very important respect, superior to many of the approaches developed especially for the purpose.

(3) A data definition that has the property of being independent of its representation in storage.

- Some standards committees have adopted the term to refer to some kind of representation of the data definition that is above the level of stored representations.
- SQL is a language that enables the preparation of a storage independent definition of data.

(4) A data definition that is common to the collections of data at two separate sites, such that it can be used as a common frame of reference when exporting data from one site and importing it at another site.

- In electronic data interchange (EDI), one needs a definition of data to be interchanged that is common to all sites involved in a set of interchanges.
- Much of the EDI work has been concerned with the specification of standard formats for an industry area, such as banking or travel. As EDI tends to adopt a more generalized approach to standardization, the need for a common definition facility becomes apparent.

(5) A data modelling facility (see CD 10032 on data management) that is different from and therefore "neutral" with respect to broadly similar data modelling facilities used in commercially available database management systems.

- Data modelling facilities are also called data models; merits of various approaches are controversial topics.
- Another "neutral" approach would lead to confusion, is not required, and is not recommended by WG3.

6.2.5.2 Conceptual Schema Standardization. (U) Work in the area of conceptual schema in ISO dates back to the early 1980s. In 1982, TC97/SC5 published *Concepts and Terminology for the Conceptual Schema and the Information Base*. This report was followed in 1985 by the *Assessment Guidelines for Conceptual Schema Language Proposals*. The 1982 document defined the "100% principle" now adopted by ISO [Ref. 72, 73]:

> All relevant static and dynamic rules, law, etc., about the universe of discourse should be described in the conceptual schema. The information system cannot be held responsible for enforcing those rules described elsewhere, particularly those described in user procedures.

(U) SC21 has agreed to hold a workshop on conceptual schema and its relationship to the Common Data Modelling Facility. It is planned to be held in the Netherlands in November 1990.

(U) ANSI has proposed that a new Question be established in SC21 to determine the use, scope, and purpose of one or more standards for conceptual schema.

The goal would be to address the need for models of a "universe of discourse." Such models are needed to clarify in a formal way the notion of a particular universe of discourse to which a standard applies (e.g., for Directory schema) and to facilitate the specification of a common universe of discourse for information exchange (e.g., for *Application Layer Structure,* ISO 9545) [Ref. 74].

6.2.5.3 Conceptual Data Modelling Facility Standardization. (U) Japan has proposed a new work item in SC21/WG3 for a conceptual data modelling facility [SC21 N 4280, February 1990]. The proposed standard would specify the facility to describe an application data model and the representation method of the result of the description of an application data model.

6.2.5.4 Object-Oriented Database Support. (U) SC21/WG3 is including in its work on SQL standardizing support for object-oriented databases. This work will impact SQL3 and potentially also IRDS and the Reference Model on Data Management [Ref. 75].

6.2.5.5 Full Text Manipulation in Structured Data. (U) SC21/WG3 is including in its work on SQL standardizing support for full text manipulation in combination with the management of structured data using SQL. SQL2 will support storage of a collection of text as a single data value, but will be capable of the complex requirements for full text manipulation [Ref. 76].

(U) Standardization of SQL metadata that goes beyond IRDS has been proposed. Currently, SQL is being used as both the IRDS modeling and implementation language. A new standard may be required for more general information modeling applications support, which would support metadata about classes of information other than those normally defined for data retrieval systems. Examples of data models for information modelling applications are binary entity-relationship data model such as IRDS, N-ary entity-relationship data model, and object-oriented data model. One effort being conducted in this area in SC21/WG3 is the Tool Integration Standard. Additional efforts on all of these models are now being conducted in the US. One standards issue in this area, as noted above, is whether relationships as well as entities should be permitted to have attributes. The OSI management information model (DIS 10165-1) has a containment relationship whose constraints could be represented as attributes of a containment relationship [Ref. 77].

6.2.6 Distributed Transaction Processing (TP) Standards

6.2.6.1 TP Reference Model. (U) A reference model for distributed Transaction Processing (TP), DIS 10026-1, has been developed by SC21/WG5. TP service elements are viewed as pertaining to the Application Layer. While TP services are discussed in relation to the DMF, some of these services may be provided by the SCF and TF.

6.2.6.2 TP Requirements. (U) The user requirements addressed by DIS 10026 are to:

- Define procedures that support distributed transactions in order to:
  - Allow a distributed transaction to be organized into a transaction tree
  - Provide multi-party coordination, including local resources
  - Allow restoration to a consistent state, following failure of the state/context of a distributed transaction and of distributed information
  - Allow the detection of failure to achieve consistency
  - Allow a distributed transaction to be restarted following successful state restoration
  - Indicate successful completion or failure of a transaction
- Provide for the delimitation of a sequence of logically related transactions
- Allow the grouping of transactions within an applications process
- Allow for access control, access control granularity on groups of TP objects, authentication, and non-repudiation
- Allow conformance testing of the protocol and delineate clearly the static and dynamic conformance requirements (through a PICS statement).

6.2.6.3 TP Standards. (U) The TP model, service, and protocol have now reached DIS status: DIS 10026--Parts 1, 2 and 3, respectively. CD 10026-4 is the *TP PICS Proforma.* DIS 10026 will be used by the RDA standard and is being considered for use by RPC, extensions to IRDS, and extensions to FTAM. It is the first Application Layer service for distributed processing [Ref. 78].

(U) An editing meeting for CD 10026-4 is planned for November 1990; DIS balloting is to begin January 1991, and the editing meeting to develop IS text is planned for September 1991. TP is dependent on a revised version of CCR, which was progressed in 1989. Two formal descriptions of TP have been produced, one in Estelle and one in LOTOS; both will be progressed as informative annexes to the TP protocol standard. TP activity will be conducted in coordination with work on RDA (WG3) and Application Layer standards (WG6).

6.2.6.4 TP New Work Items. (U) Table 7 identifies the new work items that have been proposed for TP [Ref. 79]. ISO is considering "sub-transaction" extensions to TP that would provide partial rollback and nested transactions. In the current TP standard (DIS 10026), all the bound data that are involved in a transaction tree for a transaction are committed together and, if the transaction fails, all the bound data are rolled back. Work in this area has already been done by ECMA and the US [Ref. 80].

(U) A new work item on TP security [Ref. 81] is intended to expand the TP model, service, and protocol (DIS 10026-1,2,3) to provide a secure environment for distributed transaction processing interactions involving multiple open systems. PDAD text is expected in 1992, DAD in 1993, and AD in 1994.

Table 7. (U) New Work Items Proposed in ISO for TP

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- TP Application-Context Proforma--use of OSI TP elements is expected to require the presence of one or more user application service elements (ASEs), in addition to the ACSE and the TP-ASE; therefore, some form of application context definition will be necessary [SC21 N 4165].
- TP Association Management--to provide for the management of application associations in a distributed processing environment involving multiple open systems [SC21 N 5177]. PDAD to be completed in 1992, DAD in 1993, and AD in 1994.
- TP Commitment Optimization--to improve the performance and functionality of the commitment operation of a distributed transaction. Mechanisms being considered include alternate commitment initiator, commitment indication service, explicit selection of commit coordinator, last subordinate optimization, multiple commitment initiators, real-only optimization, reversible ready, and unsolicited ready [SC21 N 4168].
- TP Data Transfer--standardizes appropriate data mechanisms to support frequently occurring models of data exchange and to allow for migration to the use of OSI TP facilities [SC21 N 4166].
- TP Dialogue Recovery--the third phase of recovery (as defined in DIS 10026-1); it is required to enable Transaction Processing Service User Invocations (TPSUIs) to continue normal operation following the re-establishment of bound data consistency [SC21 N 4170].
- TP Heuristic Decisions--provides advisory propagation of a heuristic decision to all nodes; advisory propagation to nodes in the subtree below the node taking the heuristic decision; mandatory propagation of a heuristic decision to all nodes; and mandatory propagation to nodes in the subtree below the node taking the heuristic decision [SC21 N 4167].
- TP Savepoints--service to enable a transaction to be able to save and later restore a consistent state of all bound data under its control [SC21 N 4171]; new work item not accepted by JTC1, June 1990.
- TP Security--considers requirements for provision of a secure environment for TP in areas such as access control, auditing, authentication, confidentiality, integrity, management, nonrepudiation, replay, and revocation [SC21 N 5176, approved June 1990]. PDAD to be completed in 1992, DAD in 1993, and AD in 1994.
- TP Conformance Testing [SC21 N 4172]
- TP PICS Proforma [SC21 N 4169]

Report on JTC1 SC21/WG5 OSI Transaction Processing Rapporteur Group Meeting, Florence, 1-9 November 1989, BSI IST/21:1850, A. J. Bainbridge, 14 November 1989.

(U) A new work item has been accepted by JTC1 for Data Transfer for OSI TP. Included in the scope of this work is development of TP queue services that would support transactions broken down into multiple steps. These services could also be used as the basis for a deferred transaction initiation mechanism or as a mechanism for reliable message transfer [Ref. 82].

(U) A working draft for a standard for *Unstructured Data Transfer (UDT) for OSI Transaction Processing* has been developed [Ref. 83] by SC21/WG5. This standard would allow interconnection of computer systems from different manufacturers, including those under different management, of different levels of complexity, and of different technologies. UDT is not suitable outside the TP environment. The draft consists of a model, service, and protocol for UDT and an annex for the application context for UDT.

(U) Work has begun on TP association management. The work is expected to produce an addendum to DIS 10026: CD text is expected in 1992, DIS text in 1993, and international standard text in 1994 [Ref. 84]. The statement of requirements for TP association management was issued by SC21/WG5 in June 1990 [Ref. 85]. It addresses association management objects for both application associations and application association pools, negotiations with remote systems, pool sizing, query/status information, and manipulation of the authority to release associations.

(U) Two approaches are being considered for using RPC and TP together [Ref. 86]:

- With RPC as the data transfer paradigm for TP with use being made of TP dialogue management functions
- Using TP commitment functionality to complement the operation of RPC-based services (without necessarily making use of TP dialogues) to support "exactly once" semantics.

(U) In 1989 a potentially serious problem was identified for TP. Under certain circumstances, protocol exchanges from one transaction (such as rollback) could overtake those outstanding from a previous transaction (and could therefore be interpreted by the receiving node as pertaining to the previous transaction). This can occur if lower layer expedited services are used to convey particular PDUs. The interim solution that was adopted was to avoid the use of Transport expedited data transfer services. A long-term solution to this problem is required to progress TP; the goal is December 1990.

6.2.7 Open Distributed Processing (ODP) Standards

(U) Open distributed processing (ODP) is a new area of standards development. Begun in 1987, the work has progressed so far in ISO that a new working group (WG7) has been formed in SC21 to progress the standards for an ODP Reference Model. The current work comprises the framework of abstractions (e.g., the nature of the different points of view of a system); functions and interfaces; and modelling.

(U) The Basic Reference Model of ODP is being developed in SC21/WG7. It addresses the following aspects:

- Modelling distributed processing in terms of components, the services they support, their environment, and the interactions between them
- Identifying levels of abstraction at which the services and interactions can be described
- Classifying the boundaries between components and identifying the points of interaction associated with them
- Identifying generic functions performed by distributed systems
- Showing how the elements of the model can be combined to achieve ODP.

(U) The Basic Reference Model of ODP further defines levels of abstraction at which services and interactions can be defined in other standards, generalizing the concepts of service and protocol defined in the OSI Reference Model (ISO 7498). The proposed structure of the Basic Reference Model is as follows [Ref. 87]:

- Part 1: *Overview,* containing a motivational overview of ODP, giving the scope, explained the key definitions (with no substantial architectural content), and enumerating required areas of standardization (not normative). WD is planned for 1993, CD in 1994, DIS in 1995, and IS status in 1996.
- Part 2: *Descriptive Model,* defining the concepts, analytical framework, and notation for normalized description of (arbitrary) distributed processing systems (not normative but establishes requirements for new specification techniques). WD is planned for 1991, CD in 1992, DIS in 1993, and IS status in 1994.
- Part 3: *Prescriptive Model,* specifying the required characteristics that qualify distributed processing as open--these are the constraints to which ODP standards must conform. WD is planned for 1992, CD in 1993, DIS in 1994, and IS status in 1995.
- Part 4: *User Model,* describing the resulting ODP environment from the users' point of view and containing explanatory material of how ODP is intended to be viewed by system engineers designing distributed applications to be run in the ODP environment (not normative). WD is planned for 1993, CD in 1994, DIS in 1995, and IS status in 1996.

(U) The approach of SC21/WG7 is to identify and expand a number of ODP topics in parallel. The applicable documents are:

- *Topics List--November 1989 Version--for the Basic Reference Model of Open Distributed Processing*, December 1989 [SC21 N 4019]
- *List of Open and Resolved Issues*--November 1987 Version, December 1989 [SC21 N 4020]
- *Topic 1--The Problem of Distributed Processing*, March 1988 [SC21 N 2507]
- *Topic 2.2--Properties and Design Freedoms*, December 1988 [SC21 N 3288]
- *Topic 2.3--Framework of Abstractions*, December 1988 [SC21 N 3194]
- *Topic 3--Structure of ODP Standards*, March 1988 [SC21 N 2509]
- *Topic 4.1--Structures and Functions*, December 1989 [SC21 N 4022]
- *Topic 6.1--Modelling Techniques and Their Use in ODP*, December 1989 [SC21 N 4023]
- *Topic 6.2--Formalisms and Specification*, December 1989 [SC21 N 4024]
- *Topic 7.1--Basic RM of ODP*, December 1989 [SC21 N 4029].
- *Topic 8.1--Draft Basic RM of ODP, Part II*, December 1989 [SC21 N 4025].

In addition, SC21/WG7 has prepared a set of definitions and a glossary [SC21 N 2511], and a register of documents and bibliography [SC21 N 3192].

6.3 Other Standards Activities and Emerging Standards

(U) CODASYL data management standards are the responsibility of the CODASYL Systems Committee. A report on distribution alternatives and generic architectures for distributed database systems was produced by this committee in 1980 [Ref. 88]. One of the two standard ISO data management languages (NDL) is based on CODASYL concepts.

(U) ANSI standards for database architectures are produced by the Database Architecture Framework Task Group (DAFTG) through the Standards and Planning Requirements Committee (SPARC). A draft report [Ref. 89] from the DAFTG in 1982 provided a framework to support distributed databases, multiple data models, and data dictionaries. One concept, the ASN.1, has been specified [Ref. 90, 91].

(U) In 1985, ECMA[16] issued a final draft report [Ref. 92] for remote database access service and protocol.

(U) CCITT does not provide standards for data management. The US Government Open Systems Interconnection Profile (GOSIP, see Section 9.3.3) does not address standards for data management [Ref. 93].

6.4 Options Within the Standards

(U) The ANSI standard X3.135-1986 SQL allows for two levels of compliance. Level 1 is a core standard that leaves many areas open to implementation definition. Level 2 contains many extensions over Level 1, but Level 2 still has a large number of options for implementation. Examples of facilities found in Level 2 but not in Level 1 are [Ref. 94]:

- Atomic transactions with respect to recovery
- Eighteen-character identifiers
- Table-name qualification by user-name
- Indicator variables
- Outer references
- Keyword ALL allowed in query-specifications, sub-queries, and set functions
- Updatable query-specification definitions
- Statements atomic with respect to database changes
- Not equal to comparisons (<>)
- Escape characters in the LIKE predicate
- REAL, DOUBLE PRECISION, and NUMERIC data types
- WITH CHECK OPTION on a view definition
- WITH GRANT OPTION on a privilege definition
- DISTINCT with AVG, MAX, MIN, and SUM.

6.5 Data Element Standardization

(U) The ISO has issued a draft standard (DP 7826) on the representation of data elements. This draft proposal sets out standard procedures for the identification and representation of existing and new coding systems, without providing any guidance on

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16 (U) ECMA full membership is open only to companies who develop, manufacture, and sell computers in Europe. The restricted membership makes full consensus among participants in standards-making easier and quicker to reach than in ISO.

specific coding systems.[17] It also specifies a technique for interchange of coded representations and the requirements for the administration of International Coding System Identifiers (ICSIs). This will permit the use of more than one coding system, reduce the possibility of ambiguity, reduce the need for human intervention, and diminish the time required to negotiate interchange of coded representation agreements. DP 7826 identifies three types of data element attributes: administrative, relational, and representative. These are the types of attributes described in WP 7L [Ref. 95] and recommended for ATCCIS.

(U) Substantial work has been done cooperatively by ISO JTC1/SC14 and ANSI X3L8 during the last 3 years; a draft proposal for data management is expected sometime in 1990. Once accepted by the working groups, this draft proposal will be offered to ISO for adoption [Ref. 96]. The general approach to the structure of data recommended for ATCCIS in WP 7L was derived from discussions with ISO JTC1/SC14 and ANSI X3L8.

(U) The data element naming convention and rules presented in WP 7L were derived from an emerging standard from the NIST *Guide to Data Entity Naming Conventions* [Ref. 97], which is expected to be offered to ISO in the near future. However, the rules were expanded to support the concepts and structure of data consistent with the needs in NATO, SHAPE, and ATCCIS, as well as the emerging ISO taxonomy.

(U) The US Army has recently published an Army Regulation (AR 25-9) [Ref. 98] to prescribe policies, responsibilities, and concept of operation for the management of data used in manual and automated information systems throughout the US Army. This document has been coordinated with ISO, ANSI, and the NIST, as well as with the US Joint Chiefs of Staff, to ensure alignment in the area of a data element naming convention. The US Army plans to maintain a Service-wide data encyclopedia of information about all data elements that have gone through a standardization process and are designated as Army standard elements. Additional information on AR 25-9 is provided in WP 7L.

6.6 Policy and Issues for Data Management

6.6.1 Data Management Policy in NATO

6.6.1.1 NACISA Policy. (U) There is currently no data management policy for NATO. However, a draft statement was recently developed for the

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[17] (U) ISO 646, ISO 2022, ISO 6937, and ISO 8859 are examples of standard coding systems. (See Appendix D (Section I & E.)

July 1990 meeting of the Information Systems Working Group (ISWG) of the NACISC that addresses data management policy [Ref. 99]. The statement was distributed by the Secretary of the ISWG on June 1990. It is a statement of the requirement, jointly revised and refined by staff of the ISWG and ADSIA, for a NATO data management policy. Table 8 provides excerpts from that draft statement. The conclusion is as follows:

> Recognizing that there is further detailed work which will involve or indeed depend on the actions of the organisations, e.g. ADSIA, MAS, NACISA, etc., it is concluded that the ISWG should initiate, as a matter of urgency because of the advanced stage of SD&IC, the creation of a broad Data Management Policy to embrace: Data Management, Data Integrity, Data Dictionary, [and] Data Definition; and the relationship to Data Security. From this initial action, the position of Data Manipulation [and] Data Distribution should be clarified and tasking for detailed implementation identified.

6.6.1.2 ADSIA Recommendations. (U) In April 1986, ADSIA revised a working paper [Ref. 100] on the need for standardization of data management. The following actions were recommended:

- NATO Communications and Information Systems Agency (NACISA) to identify and collect the requirements for database management systems and for standardization of database schemes, file transfers, database information exchange, and configuration management procedures
- Subsequently, the Information Systems Working Group (ISWG) to develop a NATO policy on data management and on the use of database management systems in NATO CCISs
- ADSIA to coordinate the development of technical and procedural standards for databases
- ADSIA to develop the procedural standards for database information exchange
- TSGCEE SG9 to develop technical standards for database schemes and file transfer
- NACISA to control the implementation of the developed standards and NATO policy paper to ensure the interoperability of command and control systems within the NATO CCIS.

Table 8. (U) Excerpts from the 1990 Draft Statement by NACISA on the Requirement for Data Management

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- The need for interoperability among fully automated information systems requires policies, procedures and standards of a different scope than currently available as NATO common interoperability standards. The resulting need is for a data management policy to ensure the data integrity throughout the NATO Interconnected Information System (NIIS), to include a NATO Data Dictionary to provide data definitions and a set of standards for database-to-database information exchange.
- Interoperability in the NIIS requires consistency and integrity of data throughout the system, which in turn requires NATO-wide data management standards. The use of invalid data or the incorrect interpretation of data by other information systems can be disastrous for any type of operations. Common and consistent definition of data that is subject to exchange is a prerequisite for data integrity. Data definitions are normally maintained in a data dictionary. Historically, data dictionaries have been tailored to the specific system being designed and the meanings have reflected the local users operational vocabulary. Emerging systems such as ACE ACCIS, ACCS, BICES, and ATCCIS have a requirement for a data dictionary. Only a NATO Data Dictionary can ensure that data integrity is maintained in the exchange among the various systems in the future NIIS.
- Elements of data management have been analysed to estabiish which of them, for reasons of operational interoperability, require to be subject to NATO-wide Data Management Policy. It has been concluded that the following six fall into this category to some degree:
  - Data Dictionary
  - Data Definition
  - Data Manipulation
  - Data Security
  - Data Integrity
  - Data Distribution.
- The following five elements of data management are considered not necessary to be subject to a policy, but necessary to be addressed internally in each information system. They are therefore not further considered in this policy statement:
  - Data Monitoring
  - Data Recovery
  - Data System Monitoring
  - Data Backup
  - Data Audit Trails.
- For NATO Data Management as a whole and for each of the elements identified above, a requirement exists to:
  - Define the data management element clearly,
  - Identify the policy activity necessary in its regard,
  - Identify the responsible authority for this activity, and
  - Identify the time scale, sequence and any internal/external dependencies as appropriate.

Source: *Statement of the Requirement for A NATO Data Management Policy*, Annex to AC/317(WG/2)WP/60 on Data Management, Working Paper, Information Systems Working Group, NACISA, 5 June 1990, NATO UNCLASSIFIED.

6.6.1.3 NIMP. (U) Many aspects of data management are procedural in nature and will be controlled by procedural and not technical standards. Several of these standards are also identified below. The NATO Interoperability Management Plan (NIMP)

[Ref. 101] specifically identifies standards and rules for representing data as information procedural standards and assigns the responsibility for these standards to the Allied Data Systems Interoperability Agency (ADSIA). To emphasize the role of data management in achieving interoperability, the NIMP states:

> In order for the information exchange to be effective, it is necessary that the meaning and relationships associated with that information [received from other facilities] is common and preserved, irrespective of the interoperability service and transmission media. A single common definition for all operational information throughout NATO is needed to achieve this goal.

6.6.1.4 SHAPE Policy. (U) The purpose of data management in NATO is to provide methods to ensure data availability, security, integrity, quality, and interoperability, and to provide data sharing. The ACE Manual (AM) on Data Management, AM 96-1-4 [Ref. 102], defines data as representing the elementary facts, descriptions, and qualifications about things of interest to some headquarters, unit activity, or enterprise. It further defines the role of a data dictionary as an automated tool that provides a centralized library of metadata covering all aspects of all types and structures of data residing in databases, file systems, and manual systems within an organization. AM 96-1-4 further asserts that:

- Evolution towards an ACE ACCIS will only succeed from the data management point of view by ensuring that the standardization of data definitions, the control of the data, and the maintenance of its overall integrity are systematically established on a command or site basis.
- The fundamental key to data management is the early definition and identification of data elements and, later, data fields. The definition and corresponding name should be clear, accurate, and meaningful, but reference should be given to connotation, which relates to the interpretation that bears upon the specific context of usage of data.

6.6.1.5 STC Work. (U) In 1975, Shape Technical Centre (STC) published a Technical Memorandum (TM) on data management standardization for the ACE ACCIS [TM-776, Ref. 103]. TM-776 recommends standardization of the architecture, functionality, and structure of the Data Management Subsystem (DMS) of the ACE ACCIS. These areas of standardization include data management methodologies and the tools used to design, build, and maintain the ACE ACCIS databases. TM-776 accomplished the following:

- Identified the requirement that the DMS at each ACE ACCIS node must agree on the semantics and syntax of the information exchange.
- Recommended that there be a standard ACE data definition or conceptual schema, where a schema defines all application object types, including their

attributes, relationships, and static constraints, and where a database is an instance of a schema.

- Stated that a data classification method must be used that is based on the principle of sorting data according to the type of information provided by their values, independent of their use in particular databases, messages, or applications.
- Identified the need for a methodology for formal definition of data elements based on standardized terminology, including the use of naming conventions:
  - A data element is defined as a basic unit of data that has a name, a definition, and a set of values for representing particular facts. A data element and its definition should not include any application or usage information.
  - A method is needed for analysing, defining, and controlling data elements. This method should have three components: a type classification of data elements, syntax rules for the structure and completeness of formal definitions, and a controlled vocabulary of permitted terms for formal definitions.
  - Standard data elements and relationships should be placed into an ACE common data structure.

6.6.1.6 NATO Publications on Data Management. (U) AAP-6, *NATO Glossary of Terms and Definitions (English and French)*, standardizes terminology used throughout NATO, thereby promoting mutual understanding. The criterion for inclusion is that the term be of a general military application. While earlier editions put qualifiers immediately following the term, such qualifiers are now embedded in the definition. In addition, terms and definitions are not to be composed of, nor contain, abbreviations and acronyms. A term and definition are included in the glossary only when they have been agreed upon by all nations in both English and French.

(U) The terms defined in ADatP-2 [Ref. 104], *Automatic Data Processing (ADP) NATO Glossary, English and French,* are derived from glossaries, dictionaries, and vocabularies from ANSI, American National Directory for Information Processing, ISO, International Business Machines, and ACP 167. The definitions are annotated by source and may include abbreviations, examples, notes, diagrams, accepted synonyms, contrasting terms, related terms, and cross-references for multiple uses. This information is noted when harmonization is being examined for multiple uses.

(U) ADatP-3 (STANAG 5500) [Ref. 105], *NATO Message Text Formatting System (FORMETS),* provides the rules, constructions, and vocabulary for standardized character-oriented message text formats that can be used in both manual and computer-assisted operational environments.

(U) ACP 167 [Ref. 106], *Glossary of Communications-Electronics Terms,* provides definitions of terms used by communications, electronic warfare, and operational personnel for Allied networks.

6.6.2 Data Management Issues in EDI

(U) The Special Working Group on Electronic Data Interchange (SWG-EDI) of JTC1 has identified a number of data management issues that require coordination within JTC1 (SCs 14, 18, 21, and 24) and with other Technical Committees (TCs) such as TC 46, 68, 154, and 184. The issues include [Ref. 107]:

- Ensuring a complete separation of semantic and form of data elements, for which the conceptual schema is defined at a level other than the actual applications
- Accommodating different types of data representations, specifically with regard to the data models for different types of data, so as to assure logical relationships between data of different types can be expressed
- Structuring precisely the dictionaries of data elements and groupings, to include all the attributes of data elements and to permit unambiguous reference to other directories
- Assuring coherence of dictionaries across time (updating and maintenance) and sectors and also with generic dictionaries.

6.6.3 Data Management for Distributed Applications

(U) The Workshop on Distributed Applications held by JTC1 in March 1990 noted that "very similar data management requirements are being addressed by differing standards applications" and that "potential exists for prevention of a considerable amount of duplication of effort and overlap...by increasing the extent of utilization of common aspects of data management facilities." Coordination was recommended among SC21/WG3(Database) and WG7(ODP), SC14, SC18, SC22, SC24, SWG-EDI, TC46, and CCITT SGs VII and VIII. Table 9 identifies common requirements for data structures and data models being addressed in ISO [Ref. 108].

6.7 Assessment of Coverage by Standards

(U) Until recently, there were very few standards that applied to the DMF other than those for SDL and NDL. Even so, the SDL standard is not very mature, and extensions will have to be agreed to and options reduced before SDL implementations can be expected to be interoperable.

(U) Standards for RDA and concepts for ODA show promise for use with standardizing DMF services and protocols. It is too early to tell how well these standards activities will cover DMF requirements.

Table 9. (U) Data Management Requirements Identified in ISO Relating to Data Structures and Data Models

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- Federated data models
- Mapping to user-oriented data structures/operations
- Ability to support access control to data structures
- Wide range of sizes--large and small volumes of data
- Logging of operations for audit
- Ability to combine separately defined data types (static and dynamic)
- Application-oriented operations (e.g., searching)
- Support for internationalization
- Version control (including data structure modifications)
- Distribution, transparency support, and modelling location
- Handling of uninterpreted data
- Support of different levels of consistency and data integrity
- Ability to relate families of specifications for different levels of abstraction
- Support for recursive and structured definitions
- Persistent storage of results of operations
- Ability to support pointer types
- Ability to support powerful query languages
- Support for Directed Acyclic Graphs (including selection)
- Support for uniqueness requirements
- Independence from programming languages and means of access
- Support of declaration of hotspots and triggers
- Choice of granularity

Source: *Consideration of the Data Management Component of Application Standards,* Workshop on Distributed Applications, SC21 N 4524, 23 April 1990.

(U) SC21 has identified three issues regarding its future study items, all related to databases. These issues are [Ref. 109]:

(1) There is an urgent need to develop clear views on the relationships between database activity and OSI activity. Two major areas need to be addressed:
   - Relationship between IRDS work and activity on directories, and on the structure of management information
   - Relationship between export-import requirements and distributed database work, and OSI standards, in particular those to do with the storage and manipulation of information (i.e., FTAM).

(2) There is a need to clarify conformance requirements in relation to database standards, in particular:
   - Nature of conformance statements in database standards
   - Need for, and nature of, conformance test specification standards.

(3) There is a need to clarify security requirements in relation to database standards, in particular:
   - Security needs
   - Security approaches and mechanisms
   - Relation of SC20 work to database security requirements
   - Relationship of database security needs to other security work (in particular to OSI security) and to overall system security policies.

7. THE SYSTEM MANAGEMENT FACILITY (SMF)

7.1 Description of the SMF

(U) The system management functions are identified in WP 24 as managing and updating a set of parameters that relate ensemble operations to other parts of the host system or other ATCCIS systems. The parameters (not yet specified) would be those required to ensure maximum continuity of service to the users in the event of equipment failure. The majority of system management services will be provided by the transfer of system management data using standard DMF services.

(U) The SMF is a logical entity that will interact on a peer basis as appropriate to provide specified services that cannot be provided by alternate means. Examples of system management data may be the logical-to-physical tables used by the TF and the tables defining the DMF domains.

(U) WP 24, Annex D, identifies as system management functions all activities of the system controller, system administrator, database administrator, and network administrator with the aim to control the system operations. The system management activities identified were: allocate resources, expand resources, distribute/disperse resources, move/relocate, manage crypto, manage access rights, select mode of operation, initialize, monitor system status, control system operations, and terminate.

(U) SMF works at the application level. Functionality unique to the SMF is very limited. Specifically, SMF is required to manage the concepts for Service Requests that have been identified [WP 24, Annex D] for ATCCIS. This may mean that SMF-unique functions may be ATCCIS-unique, and there may not be standards that address it. Further, most of the system management functions are expected to be provided as national-unique system management applications that use the other basic ATCCIS facilities.

7.2 Standards to Support the SMF

(U) No standards unique to the SMF have been identified. Further, none may be required.

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8. STANDARDS FOR ALL BASIC FACILITIES

(U) This chapter summarizes the status of standards in five areas: security, network (OSI) management, registration authorities, conformance testing, and formal description techniques (FDTs). Appendix F identifies organizations and standards bodies that have contributed to development of these standards.

8.1 Status of Standards for Security

(U) Security requirements for ATCCIS and other NATO Command and Control Information Systems (CCISs) include authentication, access control, confidentiality, integrity, and non-repudiation. These features are required by both civil and military systems and may be expected to be addressed by ISO and CCITT standards in the future. Specific military requirements for security and the TSGCEE recommendations for addressing these requirements will be treated in Sections 10.2 and 10.3.7.

8.1.1 Overview of Civil and NATO Security Standards

(U) Standards for security are being addressed in the following:

- ISO 7498-2 *Security Architecture.*
- DP 10181, *Security Frameworks in Open Systems,* December 1989.
- *NATO OSI Security Architecture (NOSA),* March 1988, NATO UNCLASSIFIED [Ref. 110], defines the security services, based upon ISO 7498-2, required in the NATO OSI Reference Model.
- *Security Architecture for NATO Information Systems Interconnection (SANISI) (NU),* Version 2.0, April 1989, NATO CONFIDENTIAL [Ref. 111]. SANISI is planned to be standardized as STANAG 4250-2.
- Security annexes (Annex B) for NATO OSI STANAGs 4250-56 and 4261-66 and other STANAGs planned for Layers 6 and 7 (a draft Annex B has been prepared for STANAG 4253 and 4263).
- A series of appendixes to SANISI are expected to be developed to expand on the actual implementation of a secure protocol. The first of these, Trusted Communications Sublayer (TCS), is defined in the NOSA and SANISI documents.
- Secure Data Network System (SDNS) security protocols for the network and Transport Layer. (There is a close correspondence of services between the Layer 3 SDNS security protocol and TCS [Ref. 112].)
- Extensions to SDNS protocols, such as the End-to-End Security Protocol (EESP) being developed in the UK for submission to ISO SC21/WG1.

8.1.2 Security Standards Work in ISO

(U) JTC1 SC21/WG1 has begun a number of initiatives to address the models and standards frameworks required to progress OSI security standards. Work is progressing on security enhancements to presentation standards, to association control standards, and (as necessary) to other Application Layer standards. In 1988 and 1989, WG1 circulated a number of documents to SC21:

- Plan of work on security [SC21 N 3267]
- Proposed drafts for an Upper-Layer Security Model [SC21 N 3225] and a Lower-Layer Security Model [SC21 N 3283]
- Security enhancements to presentation standards, to association control standards, and (as necessary) to other Application Layer standards
- Draft standards *Security Frameworks in Open Systems* (DP 10181)
- Discussion of the security management domain and security policies [SC21 N 3337]
- *Management Plan for Security,* November 1989; maintained as an internal SC21 document to indicate projects, priorities, and liaisons concerned with OSI security.

8.1.2.1 Security Framework. (U) DP 10181, *Open Systems Security Framework,* defines the framework within which security services for open systems are specified. These open systems include database, distributed applications, ODP, and OSI. The framework addresses data elements and sequences of operations (but not protocol elements) that are used to obtain security services. These security services may apply to the communicating entities of systems as well as to data exchanged between systems and to data managed by systems. Note that the security framework is being developed by SC21/WG1, whereas the Upper Layer Security Model is the responsibility of SC21/WG6. Table 10 identifies the scope of the individual parts of the framework.

(U) In 1990, two new projects were transferred from SC20 to SC21 in the OSI security area: (1) presentation cryptographic techniques and (2) protocol conditions for ACSE authentication. SC21/WG1 will conduct the work in these areas.

8.1.2.2 Upper Layer Security Model. (U) The Upper Layer Security Model is intended to provide the necessary basis for the development of security related protocol elements for the secure exchange of information between open systems, with the interchange of information related to security policy control and management, and with services and mechanisms for controlling access to resources accessible via OSI. It will address the following:

- Security aspects of OSI-pertinent relationships between communicating application processes
- Relationships between security services and mechanisms in the Upper Layers, to be considered in greater detail than is provided in ISO 7498-2
- Properties of the possible combinations of security services and mechanisms in the Upper Layers
- Interactions among Application, Presentation, and Session Layers in providing security services
- Placement of security functions in the Application Layer Structure (ISO 9545)
- Invocation of Lower Layer security services
- Requirements for security management in the Upper Layers.

Table 10. (U) OSI Security Framework--DP 10181

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- Part 1 (WD 10181-1), *Overview*, December 1989 [SC21 N 4210]--Describes the organization of the security framework, defines security concepts that are required in more than one part of the security framework, and describes the interrelationship of the services and mechanisms identified in other parts of the framework.
- Part 2 (DP 10181-2), *Authentication Framework*, 13 December 1989 [SC21 N 4207]--Authentication is the process of corroborating an identity. Voting results on DP 10181-2 [April 1990, SC21 N 4585) indicates that a second ballot will be required.
- Part 3 (WD 10181-3), *Access Control Framework*, December 1989 [SC21 N 4206]--Access control is the process of determining whether the use of resources within an open system is permitted. The access control framework did not proceed to a DP ballot early in 1990 due to the extensive revisions made in the Florence meeting in November 1989.
- Part 4 (WD 10181-4), *Non-Repudiation Framework*, December 1989 [SC21 N 4209]--Non-repudiation is a security service that provides proof of origin or delivery of data in order to protect the sender against the false denial by the recipient, that the data has been received, or to protect the recipient against false denial by the sender that the data has been sent. The use of appropriate mechanisms is coupled with the necessary assurance mechanisms providing proof about certain properties of the communications between the entities involved, such as its integrity, origin, time, and destination. Non-repudiation implies the existence of an agreed third party whose primary role is to arbitrate disputes resulting from non-repudiation.
- Part 5 (WD 10181-5), *Confidentiality Framework*, December 1989--There were no substantial contributions to the confidentiality framework in November 1989 and it remains as only a list of planned contents.
- Part 6 (WD 10181-6), *Integrity Framework*, December 1989 [SC21 N 4208]--The integrity framework addresses the constancy of a data value and not any other form of invariant that such a value may possess. In particular, it does not address the constancy of any information that the data is deemed to represent. There are two types of integrity mechanisms needed for two types of constancy. The first is the constancy of the value of data in an environment in which a *random* modification to integral data may be made. The second is the constancy of the value of data in an environment in which a modification to integral data may *deliberately* be made to defeat the integrity mechanism.
- Part 7 (WD 10181-7), *Audit Trail Framework*, December 1989.

8.1.2.3 Requirements and Approaches for Security. (U) In March 1990 at the Workshop on Distributed Applications in Phoenix, the following observations on security were made [Ref. 113]:

- It is highly desirable to standardize a general approach to providing security in the Application Layer. This can be accomplished by supporting a variety of security methods that involve communication of security information. Examples of such methods could be:
  - Two-way or three-way authentication exchange
  - Privilege attribute certificate transfer
  - Key negotiation sequence.
- A security method would consist of semantics, syntax, and procedural rules relating to the communications aspects of the method.
- There appear to be three possible OSI architectural approaches to supporting security methods:
  - No generic security ASE(s), in which the syntax and procedural rules for any security method are imported into the specification of an application-specific ASE.
  - One generic ASE, in which one ASE is provided that can import into its abstract syntax the syntax of any security method. Possibly, the procedural rules associated with all security methods could be incorporated into the ASE specification.
  - Multiple purpose-specific security ASEs, in which each ASE incorporates the procedural rules and syntax for a particular security method or group of closely related methods (e.g., an ASE to support two-way authentication exchanges).
- Satisfaction of security requirements of TP, Directory, and OSI Management will depend on addressing security modelling issues related to distributed applications. The Upper Layer Security Model includes this in its scope, but the current draft of the model suggests little will be done in this area when it is first released.
- Access control to data resources must address the data model being used by individual applications such as DFR, DTAM, FTAM, IRDS, etc. Use of a common data modelling approach provides the potential for use of common access control facilities to such data resources and consequently increases the attractiveness of the common data model approach in order to prevent the need for re-specification of access control facilities for data management applications.

8.1.2.4 FTAM Security. (U) Most FTAM security appears to be based around access control lists, such as listing "people" and "groups of people" that are or are not allowed access. Change of access control lists is a procedural matter outside of OSI. FTAM can pass names and passwords (both encrypted and unencrypted), but this may better be supported with the Peer Entity Authentication framework of ISO 10181

[Ref. 114]. This approach may not be general enough to address all types of access control (e.g., label-based security as mandated in the Orange Book).

8.1.2.5 TP Security. (U) A new work item is being drafted in SC21/WG5 for Transaction Processing security.

8.1.2.6 ODA Security. (U) Changes are being made to ODA, ISO 8613, to improve the security aspects. ODA provides protection for documents as a whole or for parts of a document. Confidentiality, integrity, authentication, and non-repudiation of origin are all supported using encipherment, fingerprints, and seals [Ref. 115].

8.1.2.7 Directory Security. (U) An access control framework for the Directory was recommended for DP status at the November 1989 meeting in Florence. A second DP ballot is planned in 1990, DIS status in 1991, and International Standard status in time for the next CCITT meeting in 1992. Access control is planned to be available at the attribute value, attribute type, directory entry, and domain levels. Two types of access control rules would be supported: (1) absolute access controls that are evaluated with outer domains taking precedence, and (2) default access controls that are evaluated with inner domains taking precedence. If no access control rules are found of either type that refer to an individual access, access is denied. The types of accesses controlled include manage, administer, compare, read, add, delete, and modify.

(U) The need for a key management framework has been identified by SC21/WG1. A liaison statement between SC21 and SC27 for such a framework is planned for 1990 [Ref. 116].

8.1.2.8 Database Security. (U) SQL2 specifies some security functionality but the standard (ISO 9075) does not address how a secure database should be built. Since the security of the operating system needs to be considered in building a (secure) database, POSIX standards are also relevant to the security of databases.

8.1.2.9 Layer 3 Security. (U) The UK plans to submit a proposal for an end-to-end security protocol (EESP) that operates at the top of Layer 3 as a separate protocol. EESP may require changes to ISO 8648, *Internal Organization of the Network Layer* [Ref. 117].

8.1.2.10 Proposed ASE for Security. (U) CCITT SG VII has identified a need to define an ASE capable of providing arbitrarily complex n-way security exchanges, where such exchanges could occur in conjunction with association establishment or after an association has been established. The SG VIII proposal [Ref. 118] identifies such application-layer exchanges as peer-entity authentication exchanges, exchanges of keying information, and combinations of these. The proposed

Security Exchange Service Element would address ACSE shortcomings: peer authentication in ACSE (ISO 8649 DAD1) applies only at the time of association establishment and is limited to a single two-way exchange.

(U) A new work item on security exchange ASE has been adopted by SC21 that will provide for the transfer of information between a pair of application-entity invocations in support of security services such as authentication, access control, confidentiality, and integrity. The security exchange would be allowed to occur either in conjunction with association establishment or at any time on an established association. Encryption/signature functions could be located in either the Application Layer or the Presentation Layer. A standard method for defining security exchange information using ASN.1 would be defined as part of this work item [Ref. 119].

8.1.2.11 Security Exchange Information. (U) Canada has proposed the following approach for introducing a flexible means of generating protocols to support general-purpose security services in the Application Layer [Ref. 120]:

- Identify concepts of security exchange and security exchange information (SEI) and general approaches to defining such information
- Provide an ASN.1 framework for defining SEI to support the incorporation of SEI into existing or new Application Layer protocols based on ASN.1
- Specify a generic security-exchange ASE that provides a standard means of transporting SEI in application contexts where no other ASE provides for this transport.

8.1.2.12 JTC1 Workshop on Security. (U) JTC1 has scheduled a Workshop on Security in London during 5-7 November 1990. JTC1 participants are expected from the Special Working Group (SWG) on Security, SWG-EDI, SC6 (WG2/WG4), SC17(WG4), SC18(WG1/WG4), SC21(WG1), SC22 (POSIX Security), and SC27. Additional participants are expected from TC68 and TC154. The security topics proposed for this workshop are wide ranging and indicate the scope of ongoing work and areas envisioned for standardization in the next 5 or more years [Ref. 121]:

- Information security technology
- Information security risk analysis methodology
- Access control to applications and or security objects (e.g., for confidentiality and integrity)
- User authentication
- Indirect access to security objects or delegation mechanisms

- Physical security in such areas as biometrics equipment, TEMPEST equipment, tamper resistance, computer room design, and card access control equipment
- Network security management
- Network access control
- Syntax and data elements for audit trails
- Secure version of OSI protocols (e.g., Data Link Layer, Transport Layer, upper layers)
- Secure versions of EDI
- Secure versions of standards for office documentation
- Standards for secure application design
- Secure versions of databases
- Generic security techniques and mechanisms in such areas as message authentication, digital signatures, peer entity authentication, and key management
- Security of distributed applications
- Security of transaction processing
- Information technology security evaluation criteria
- Integrated circuit cards security.

8.1.3 Security Standards Work in NATO

8.1.3.1 TSGCEE SG9 AHWG on Security. (U) The TSGCEE SG9 Ad Hoc Working Group (AHWG) on Security is developing the NOSA and SANISI documents, whereas the security annexes for the layer STANAGs are the responsibility of TSGCEE SG9 WG1 and WG2. NOSA was developed to give guidance to contractors and procurement managers on the preferred placement of security services within OSI-conformant systems. SANISI provides more detailed rationale on the placement of security services and mechanisms within the NATO OSI Reference Model. The emphasis has been to derive appropriate refinements and augmentations to ISO 7498-2 so that a comprehensive set of security facilities can be defined to satisfy the NATO secure interoperability requirements. SANISI is expected to remain classified for the foreseeable future. Annexes in SANISI are planned to address LANs, security management, and TCS services. There are some terminology differences between NOSA and SANISI; otherwise these documents are considered stable. The AHWG on Security has also developed a classification guide [Ref. 122].

(U) The TCS architecture has been broken down into five functional modules. A description of this internal architecture was presented at the SHAPE Technical Centre Military OSI Symposium in June 1990 [Ref. 123]. Two of the five TCS modules identified so far now have service definitions and protocol specifications in draft form [Ref. 124]. Work is continuing in the AHWG on Security to make the TCS conform to the eventual security protocol agreed by ISO--only the implementation would be unique to NATO. Further, security issues have been identified by the AHWG on ISDN; when a security architecture is defined for ISDN, that architecture will be assessed to see how it relates to NOSA.

8.1.3.2 NOSA. (U) NOSA identifies OSI security services for the Physical, Network, and Presentation/Application Layers. These are [Ref. 110]:

- Physical Layer will provide two services by transparent means without requiring modifications to the Physical Layer protocols:
  - Connection confidentiality, which is capable of dealing with circumstances where the physical communication is intermittent or asymmetric.
  - Traffic flow confidentiality.
- Network Layer security services are provided within subnetwork-dependent roles and within a TCS:
  - Subnetwork-dependent services are peer entity authentication, data origin authentication, access control, connection confidentiality, connectionless confidentiality, traffic flow confidentiality, connection integrity without recovery, and connectionless integrity.
  - Security services that can be provided by the NATO TCS are identical to the eight identified above for subnetwork-dependent roles.
- Presentation/Application Layers could provide as many as 14 security services:
  - The eight services identified above for the Network Layer.
  - The following additional six services: selective field confidentiality, connection integrity with recovery, selective field connection integrity, selective field connectionless integrity, non-repudiation with proof of origin, and nonrepudiation with proof of delivery.

8.1.4 Other Security Standards Work

8.1.4.1 Secure Data Network System (SDNS). (U) The goals of SDNS are to create specifications for end-to-end security; to utilize the OSI Reference Model; to design an architecture to include electronic mail and end-to-end encryption; to provide transparent key management; and to demonstrate feasibility of techniques. The US National Security Agency (NSA) is supporting the SDNS project [Ref. 125], which has released to the public domain several standards for security protocols [Ref. 126-136]. The elements of SDNS are described in Table 11.

Table 11. (U) Security Protocols Developed in SDNS

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- Security Protocol 3 (SP3). Provides various security services in the Network Layer through the use of cryptographic mechanisms; SP3 is a subnetwork independent convergence protocol (SNICP, ISO 8648) that extends the CLNS (ISO 8348/AD1) with confidentiality (protection against passive monitoring), integrity (protection against modification, replay, addition, or deletion), or both. SP3 is designed to be used at the top of Layer 3 [Ref. 126].
- Security Protocol 4 (SP4). Specifies optional extensions of the COTS (ISO 8072) and connectionless transport service (ISO 8072/AD1) for the Transport Layer. The extensions permit the use of cryptographic techniques to provide data protection for transport connections for connectionless-mode Transport Protocol Data Unit (TPDU) transmission. SP4 can be used with the CONS or the CLNS. SP4 is designed to be used at the bottom of Layer 4 [Ref. 127].
- Message Security Protocol (MSP). Defines additions to the CCITT X.400 (either 1984 or 1988) that permit any type of message (including interpersonal messages) to be sent and received securely. When used with the conventions defined by ANSI for the X.400 Message Transfer System, MSP can be used to exchange EDI messages securely. The MSP provides writer-to-reader confidentiality, access control for message transfer, and request for a signed receipt of the received message. SDN 701 [Ref. 129] specifies the MSP, and SDN 702 [Ref. 130] defines new attribute types and object classes for inclusion in the X.500 Directory in support of key management functions used by MSP.
- Key Management Protocol. Key management provides for the generation, distribution, and updating of traffic encryption keys (TEKs). The abstract model for a Key Management Application Process (KMAP) consists of two parts: the information processing part that is supported by Management Information Bases (MIBs) for keys and for TEKs, and the communication part, called the Key Management Application Entity (KMAE). The KMAE consists of the Layer 7 ACSE (ISO 8649) and a Key Management Application Service Element (KMASE). The Key Management Protocol provides Layer 7 peer-level services between the KMASEs of two KMAPs. The Key Management Protocol assumes the use of the connection-oriented presentation services (ISO 8822) [Ref. 128, 134-136].
- Access Control. Access control is the prevention of the unauthorized use of a resource, including the prevention of use of a resource in an unauthorized manner (ISO 7498-2). SDN 801, SDN 802, and SDN 802/1 [Ref. 131-133] specify an access control framework based on a four-tiered model and an Access Control Information System (ACIS) that provides a uniform method for encoding access control information that is independent of any particular security policy. The ACIS also provides a standard algorithm for interpreting and comparing access control attributes. The access control framework provides for authentication data and access control checks that will allow communication between different SDNS users/systems when their respective security policies allow it. The framework provides two processes: a Peer Access Approval process for interpreting the data of the four-tiered mode, and the Peer Access Enforcement Process for enforcing access control on a Protocol Data Unit (PDU) basis [Ref. 131-133].

(U) The SP3 protocol is comparable to the TCS requirement identified by TSGCEE SG9. However, it does not meet all the TCS requirements and it requires a CL network services. For example, traffic flow confidentiality is not supported by SDNS. The UK has recently introduced the EESP, which could address the TCS requirements more fully, and support services for CO networks [Ref. 137]. There is some question as to whether the security models and the mechanisms that provide security services

underlying SDNS and the TCS are so different that SDNS can meet the TCS requirements [Ref. 138].[18]

(U) NSA is working with NIST to incorporate the SDNS protocols into US GOSIP. The SDNS protocols will also be introduced into the ANSI by NIST and, if accepted, into the ISO OSI Security Architecture. SP3 and SP4 have already been submitted by ANSI to ISO: SP4 has been accepted as a new work item, and SP3 is expected to be accepted as a new work item after some modifications. Testing of breadboard hardware with the SDNS protocols was conducted in 1989.

8.1.4.2 NIST Recommendations. (U) The NIST approach to OSI security standards includes the following features [Ref. 139]:

- Security encapsulation standard to provide cryptographic protection of integrity and confidentiality. A common format and processing standard that is independent of the algorithm to be used is needed.
- Security Protocol at Layer 2 (SP2), between the logical link control and the media access control protocols. This is being developed by IEEE under P802.10 as a Standard for Interoperable LAN security (described below).
- Security Protocol at Layer 3 (SP3). There are four subclasses: N-no routing, A-routing but no fragmenting and reassembly, I-fragmenting and reassembly, and D-fragmenting and reassembly for DoD Internetwork Protocol.
- Security Protocol at Layer 4 (SP4).
- Mail handling security system for MHS, to be used between the User Agent and the Transfer Agent to encapsulate the entire message contents; this requires posted keys and certificates. (One candidate is from X.411; another is the MSP from SDNS.)
- Cryptographic key management, a service to be provided at the Application Layer to support real-time (SP2, SP3, and SP4) as well as posted (MHS) requirements. Current proposals are based on private key (ANSI X9.17) or public key (SDNS) techniques.
- Security labels and labelling. These are planned to be strongly coupled with data.
- Authorization and access control. These features would permit policies to be specified within security domains and would support multiple policies and models (candidates are from ECMA and SDNS).

In addition, NIST is developing standards for digital signature and nonrepudiation where a message and the identity of the sender are cryptographically combined in such a way that

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[18] (U) In a private communication with Clive Walmsley, RSRE, in March 1990, a comment was made that the prospect of interoperability between the two models would be remote.

any unauthorized change to the message is detectable and the originator cannot deny creating the message. This feature would require trusted notarization and storage. Finally, NIST is developing standards outside the OSI model for personal identification and authentication. Approaches include knowledge, token, or physical means. Technologies being considered include a smart card and use of passwords.

(U) The NIST OSI Implementor's Workshops have a Special Interest Group (SIG) on OSI Security Architecture. The purpose of this group is to develop an overall OSI security architecture that is consistent with the OSI Reference Model and that economically satisfies the primary security needs of both the commercial and Government sectors. The SIG on OSI Security Architecture plans to address key management and security management functions that must be performed between the layers and the peer entities defined in the OSI architecture. Once SP3 and SP4 are adopted as Draft International Standards, the SIG on OSI Security Architecture can consider them for Interim OSI Implementor's Agreements.

8.1.4.3 ECMA Recommendations. (U) In July 1988, ECMA issued a technical report (TR46) entitled *Security in Open Systems--A Security Framework* [Ref. 140]. This document describes a framework for the development of security provisions in the Application Layer.

8.1.4.4 IEEE Work on Secure Local Area Networks (LANs). (U) Draft standards are being developed for secure LANs. IEEE P802.10 has released (January 1989) a draft of the Standard for Interoperable LAN Security (SILS) [Ref. 141]. The draft standard provides different service interfaces for key management, secure data exchange, and system management. System management primarily addresses security management, but may be expanded to include fault, performance, and configuration management as well. In addition, IEEE P802.2 is considering an optional security sublayer for logical link control [Ref. 142].

8.1.4.5 BLACKER. (U) On the Defense Integrated Secure Network (DISNET), the Defense Communications Agency (DCA) operates a standard end-to-end encryption (E3) system called BLACKER. A BLACKER front end (BFE) device is installed on each host-to-switch access path of all hosts used by subscribers, including terminal access controllers. The BLACKER system includes key distribution center (KDC) and access control center (ACC) hosts that automatically manage encryption keys via DISNET. BLACKER ensures that no network malfunction can permit or cause an unencrypted packet to be delivered to a host not authorized to receive it [Ref. 143-145].

(U) BLACKER is designed to satisfy Class A1 of the DoD Trusted Computer System Evaluation Criteria (TCSEC), also known as "the Orange Book," by encrypting the application data in each X.25 packet while leaving header data unencrypted for backbone use. BLACKER makes DISNET multilevel secure in three ways. First, BLACKER separates subscriber security communities from each other, allowing the DISNET communities to share one backbone. Second, on the host side, the BFE recognizes a security label on each packet, allowing DISNET to serve a multilevel secure host through one BFE. Third, BLACKER separates the entire host community on one side of the BFEs from the backbone on the other, allowing the backbone to operate at a lower, less costly security level.

(U) The host interface to the BFE is based on standards defined for the 1983 DDN X.25 interface, and requires that the Internet Protocol (IP) be used as the next layer above X.25. The BFE presents a Data Circuit-Terminating Equipment (DCE) interface to the host. Only DDN "Standard Service" X.25 is offered at the host interface; no provisions for "Basic Service" will be made.

(U) The BFE conforms to the following Layer 3 specifications [Ref. 145]:

- *Defense Data Network X.25 Host Interface Specification,* DCA, December 1983.
- *Interface Between Data Terminal Equipment (DTE) and Data Circuit Termination Equipment (DCE) for Terminals Operating in the Packet Mode on Public Data Networks,* Recommendation X.25, CCITT, 1980.
- *WD2512 X.25 Packet Network Interface (LAPB),* Western Digital Corp., 1989.

(U) In the fall of 1989, a multi-Service demonstration that used BLACKER communications security and off-the-shelf gateways and routers was held in the US. The Integrated Tactical-Strategic Data Networking (ITDN) demonstration was attended by the ATCCIS PWG. ITDN used only non-developmental item components, standard data communications protocols (X.25 with TCP/IP), and existing military communications systems. ITDN interconnected automated systems at multiple echelons at widely dispersed (over 1,000 miles) locations with multiple-security-level interconnected networks.

(U) Work similar to BLACKER is being done in other NATO nations to achieve the same ends.

8.1.4.6 Computer Security (COMPUSEC) Guidance. (U) In order to guarantee secure handling of data and information technology systems, it is

necessary to comply with security standards appropriate to the respective risks in differing operational environments. The most commonly referenced security standards in NATO for COMPUSEC guidance are [Ref. 146-150]:

- *IT-Security Criteria, Criteria for the Evaluation of Trustworthiness of Information Technology (IT) Systems*, published by the Zentralstelle für Sicherheit in der Informationstechnik (ZSI,German Information Security Agency) in 1989.
- *Computer Security Requirements--Guidance for Applying the Department of Defense Trusted Computer System Evaluation Criteria in Specific Environments (Yellow Book)*, issued by the DoD Computer Security Center (DoDCSC) in June 1985.
- *Technical Rationale Behind CSC-STD-003-85: Computer Security Requirements--Guidance for Applying the Department of Defense Trusted Computer System Evaluation Criteria in Specific Environments (Yellow Book Rationale)*, issued by DoDCSC in June 1985.
- *Department of Defense Trusted Computer System Evaluation Criteria (Orange Book)*, issued under the authority and in accordance with DoD Directive 5200.28 in December 1985.
- *Trusted Network Interpretation (Red Book)*, issued by the National Computer Security Center in July 1987.

8.2 Status of Standards for OSI Management

(U) The OSI Reference Model identifies three areas of OSI management: systems management, layer management, and application process management. Development of international civil standards for the overall management architecture and for systems management is being coordinated through SC21 WG4 on OSI Management.

(U) Figure 10 identifies the classes of OSI management standards and indicates the relationships among these classes. ISO standards are identified where they apply. One standard, CD xxxxx, *Guide to Systems Management*, has not yet been drafted. It will be informative, independent of the other standards, and based on the guidelines contained in the early working documents on the five management functional areas: fault, configuration, security, accounting, and performance.

(U) All the Systems Management CD/CDAM progressions were passed by SC21 in June 1990. One of the NWI items failed--the proposal for a formal description of the CMIP.

(U) Work is progressing in SC6/WG2&WG4 on OSI management in the lower layers. A working draft specification of the elements of network layer management

information has been developed [February 1989] and circulated to SC6 and SC21 [SC6 N 5448, October 1989; and SC21 N 4347, January 1990]. SC6 has developed a set of general principles for the definition of lower layer management [SC6 N 5784, January 1990; SC21 N 4630, April 1990]. These principles extend and refine the *Guidelines for the Definition of Managed Objects* (DIS 10165-4).

8.2.1 Development of OSI Management Standards

(U) Network management standards are being developed by the ISO/IEC JTC1 SC21/WG4. TSGCEE SG9 activities have been directed at identifying issues and positions of concern to military applications and influencing the direction of the work in ISO/IEC. The emphasis of the TSGCEE SG9 issues has been in the area of quality of service (QoS).

8.2.2 ISO Approach to OSI Management[19]

(U) OSI Management concerns itself with three things: inter-system communications carrying management information, structure of the management information, and management functions to be undertaken by end systems. There are three ways by which management information is communicated:

- Systems Management protocols at the Application Layer
- Layer management protocols at lower layers
- Normal operation of layer protocols.

Systems Management is the preferred method. The others are required only because OSI Management concerns the resources and activities needed to monitor and control the open communications environment. They are not required for management outside OSI Management.

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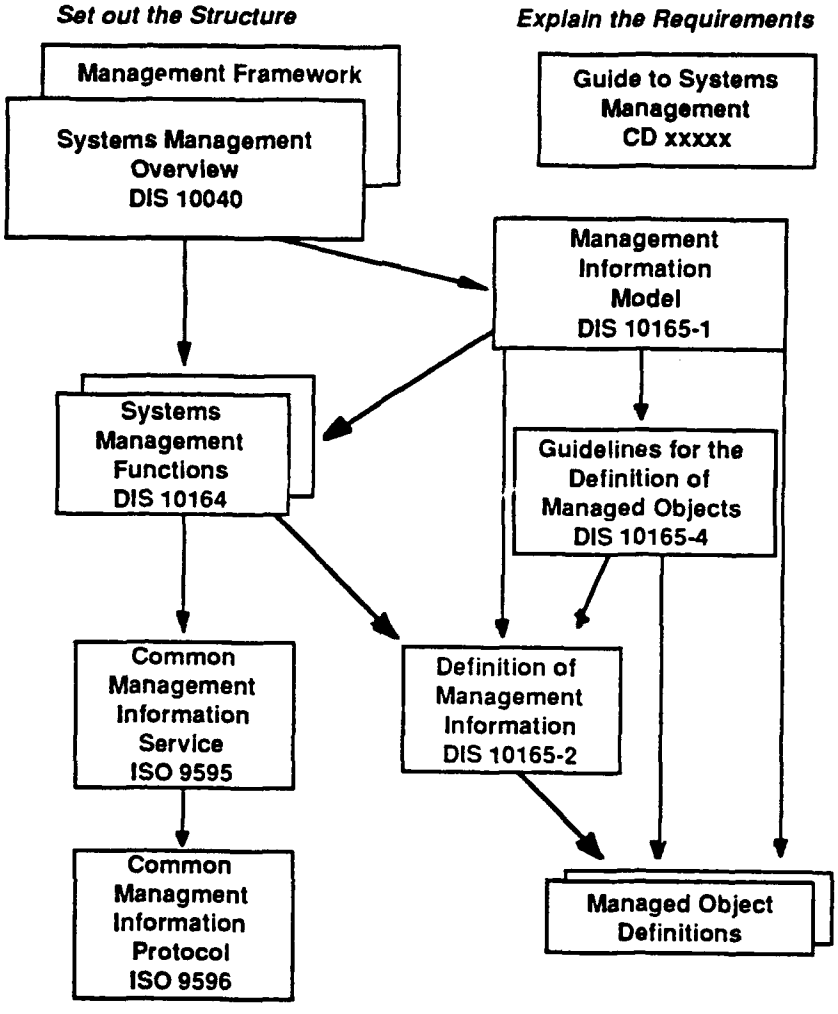
19 (U) The discussion of the ISO approach to OSI management is taken from a working paper, *Open Distributed Management Standards--The OSI Management Approach*, A. Langsford (British Standards Institute IST21/P4 Chair), July 1989, UNCLASSIFIED.



Source: DIS 10040, *Systems Management Overview*, SC21 N 4865, 29 May 1990, UNCLASSIFIED.

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Figure 10. (U) Application Functional Profiles

(U) Systems Management uses a Common Management Information Protocol (CMIP) to communicate information between systems. This identifies information to be transferred and whether the transfer concerns an event report or an operation. Event reports are generated to notify another system of an asynchronous happening. Operations can monitor data and can exercise control either by assigning data values or initiating actions through a synchronous communi :on between end-systems.

8.2.2.1 Functional Areas. (U) Establishing the scope of OSI Management is deemed necessary to establishing a consensus concerning the requirements. This led to identifying five functional areas for management: fault management, configuration management, accounting management, performance management, and security management. Although this approach had some advantages in resolving basic elements of functionality, it also exercised a constraining influence over the organization of work. Each functional area became concerned with its narrow perspective. This led to questions concerning the interplay between functional areas, exemplified by the following: "How does one handle standards for reconfiguring a system once a fault has been detected?"

8.2.2.2 Focus on Managed Objects. (U) A clarification came from a shift of emphasis to the data of concern to management. Only when the data have been defined are the functions, which use the data through monitoring or controlling activities, considered. This has resulted in simpler functional standards. Each function can now stand alone rather than being bound into a composite document covering all the functions conceived as belonging to a particular area. It also enabled functions that cross the preconceived functional area boundaries to be handled in a natural manner. The result is that a particular function can be issued as a CD proposal when it is deemed to be technically stable without being unduly delayed by less mature work considered as belonging to the same functional area.

(U) With this shift of emphasis towards data, the aim is now to identify the objects of concern to management, their attributes, and the operations that may be performed upon them. The communication services are thus the vehicles for carrying the values of attributes and a coded field identifying the operation to be carried out on a specific object, not for carrying information specifying a functional area. The approach is very close to (but not quite identical with) object-oriented methods. It has meant that work has concentrated on the management interchanges between systems performing a managing role and systems operating in an agent role manipulating internal managed objects. There has been little investigation of management exchanges between peer, managing entities, or of the management procedures invoked by managers.

(U) The object-oriented approach has enabled OSI Management experts, in collaboration with those developing standards for various OSI layer protocols, to identify classes of managed objects and commonly used attributes. This in turn has promoted the development of a standard naming scheme through which to identify instances of object classes. The naming scheme is based on that used for Directory

services. This facilitates the use of directories, conforming to ISO 9494 (CCITT Recommendation X.500), when management makes references to OSI objects.

8.2.2.3 Distributed Processing Aspects. (U) The shift of emphasis has been further beneficial in bringing into relief the fact that some management has been recognized as a distributed processing activity with its own managed objects. For example, the "event forwarding discriminator" takes management decisions about what should be done to asynchronous notifications flowing from OSI managed objects.

(U) Thus, OSI Management standards are beginning to reveal explicitly what has always been known by management specialists; i.e., management is a distributed processing activity and has much in common with other distributed processing activities. Management's distinguishing feature is that the scope of the distributed application is limited to manipulating the information processing, storage, input/output, and communications environments themselves. Hence, particular attention is paid to controlling the permission to obtain an act upon system information.

8.2.2.4 Results of Work in OSI Management. (U) OSI Management has had a long learning process. The lessons learned have been valuable and appear to be applicable to management in general. The following steps are important in creating new management standards:

- Establish a requirement, since this sets the scope for the standard.
- Identify the objects of concern to management through which that requirement is realized. With identification of the objects goes the identification of their attributes, operations, and of any objects that can be encapsulated within the identified objects.
- Establish a naming scheme for the objects and their attributes.
- Identify management procedures that, through monitoring and controlling activities, meet the requirement. Where a procedure requires inter-system communication, the communication is provided through the use of CMIP.

(U) The Structure of Management Information (SMI) standards for OSI set out rules for specifying managed objects, attributes, and their operations. Although detailed investigations remain to be carried out, first impressions are that these rules are applicable to all aspects of management. However, it could be that further investigation will reveal places where detail may need to be refined.

(U) OSI Management standards identify a number of attributes that are common to many management activities (e.g., counters, gauges, thresholds, status, logs) and many events that have general applicability (e.g., fault reporting, exception handling). Though not yet as well developed, it appears that OSI management procedures for testing,

accounting, managing, and accessing logs have the same general applicability. Adopting this work as a basis and providing extensions where required will (a) obviate rework, (b) help limit the unnecessary proliferation of managed standards, and (c) help reduce the diversity of management software that suppliers have to write to support open distributed management.

(U) In communicating related sets of operations to be performed or invoking remote operations, a managing system may wish to assert relative priorities to various tasks. If and how priority should be handled and communicated through CMIP is an open question.

8.2.2.5 Conformance. (U) SC21/WG4 has only begun to describe how conformance statements should be constructed so that they apply meaningfully to OSI Management. The one exception is CMIP for which, being a conventional Application Layer protocol, the task of generating conformance statements is straightforward.

(U) The main problem is that OSI Management is concerned not just with "how" something is communicated (CMIP) but "what" is communicated (SMI) and "why" (management functions and procedures). Whereas conformance and particularly the demonstration of conformance through conformance testing is readily applied to CMIP since the communication is visible and monitorable, the "what" and "why" require that conformance testing be applied to activities taking place within end systems. There is a need to investigate whether the approach of the OSI Conformance Testing Methodology is applicable or whether another method needs to be developed. Any method must recognize the distributed nature of management operations and so would probably be appropriate to other classes of distributed processing enterprise.

(U) Consideration of conformance to management standards, with the wider scope of open distributed processing, could have the beneficial effect of clarifying the conformance requirements, conformance clauses, PICS proformas (or the equivalent), and profiles for OSI Management standards [Ref. 151].

8.2.3 ISO Standards for OSI Management

8.2.3.1 Status of OSI Management Standards. (U) The following are the standards documents being developed in ISO by SC21/WG4 for OSI management:

- *OSI Management Framework,* ISO 7498-4, November 1989. The Framework document provides an architectural overview (CCITT X.700).
- *Systems Management Overview,* DIS 10040, May 1990 [SC21 N 4865]; a meeting is scheduled for June 1991 to resolve comments on the DIS ballot.

The *Overview* document provides more detailed architectural concepts. It may contain normative material that an implementor must know but will probably not contain specific requirements that would be reflected in conformance testing. The DIS balloting for the *Overview* (and the first seven parts of DIS 10164) will take 6 months; it will be followed by a period to review and respond to ballot comments. The editing meeting will be in June or September 1991, after which the international standard text could be issued (CCITT X.701).

- *Systems Management*, DIS 10164:
  - Part 1: *Object Management Function*, DIS 10164-1, July 1990 [SC21 N 4067, December 1989]--editing meeting on responses to DIS balloting for Parts 1-7 planned for June 1991 with IS status at the end of 1991 (CCITT X.730).
  - Part 2: *State Management Function*, DIS 10164-2, July 1990 [SC21 N 4068, December 1989] (CCITT X.731).
  - Part 3: *Attributes for Representing Relationships*, DIS 10164-3, July 1990 [SC21 N 4069, December 1989] (CCITT X.732).
  - Part 4: *Alarm Reporting Function*, DIS 10164-2, July 1990 [SC21 N 4070, December 1989] (CCITT X.733).
  - Part 5: *Event Report Management Function*, DIS 10164-5, July 1990 [SC21 N 4071, December 1989] (CCITT X.734).
  - Part 6: *Log Control Function*, DIS 10164-6, July 1990 [SC21 N 4063, December 1989] (CCITT X.735).
  - Part 7: *Security Alarm Reporting Function*, DIS 10164-7, July 1990 [SC21 N 4064, December 1989] (CCITT X.736).
  - Part 8: *Security Audit Trail Function*, CD 10164-8, July 1990 [SC21 N 4955]--editing meeting on responses to CD balloting for Parts 8-11 planned for March 1991; open issues would be discussed at the May 1991 SC21 plenary meeting. DIS balloting could begin later in 1991 with IS status in 1992 (CCITT X.740).
  - Part 9: *Objects and Attributes for Access Control*, CD 10164-9, July 1990 [SC21 N 4956] (CCITT X.741).
  - Part 10: *Accounting Meter Function*, CD 10164-10, July 1990 [SC21 N 4958] (CCITT X.742).
  - Part 11: *Workload Monitoring Function*, CD 10164-11, July 1990 [SC21 N 4959] (CCITT X.739).
- *Structure of Management Information (SMI)*, DIS 10165 (a meeting is scheduled in June 1991 to resolve comments on DIS ballot):
  - Part 1: *Management Information Model*, DIS 10165-1, July 1990 [SC21 N 4484] (CCITT X.720).
  - Part 2: *Definition of Management Information* , DIS 10165-2, July 1990 [SC21 N 4867] (CCITT X.721).
  - Part 3: Cancelled in November 1989 by recommendation of SC21 and incorporated into Part 2.
  - Part 4: *Guidelines for the Definition of Managed Objects*, DIS 10165-4, 15 June, 1990 [SC21 N 4852].

- *Common Management Information Service (CMIS) Definition,* ISO 9595 (formerly DIS 9595-2), January 1990 [SC21 N 33874] (approval was received at the SC21 meeting in Seoul in June 1990 to proceed to IS status); CCITT and ISO/IEC are collaborating on CMIS and CMIP. CMIS defines services for acting on an object and include creation and deletion. Services can apply to values from a set of attribute values; the attribute values can have the structure of a table, so that services can affect entries, entire rows, and entire columns (CCITT X.710).
  - DAD 1: *CancelGet Service,* February 1990 [SC21 N 3876].
  - DAD 2: *Add/Remove Service,* February 1990 [SC21 N 3877].
  - PCDAM 3: *Support of Allomorphism,*[20] July 1990 [SC21 N 4966] (CDAMs for CMIS and CMIP are expected in November 1990).
  - PCDAM 4: *Access Control,* July 1990 [SC21 N 4999]; CMIS has an access control field--the issue is how to use it.
- *Common Management Information Protocol (CMIP) Specification,* ISO 9596 (formerly DIS 9596-2) [SC21 N 3698]; CMIP defines peer protocols for layer services between Systems Management entities (CCITT X.711).
  - DAD 1: *CancelGet Protocol,* February 1990 [SC21 N 3878].
  - DAD 2: *Add/Remove Protocol,* February 1990 [SC21 N 3879].
  - PCDAM 3: *Support of Allomorphism,* July 1990 [SC21 N 4967].
  - PCDAM 4: PICS Proforma, July 1990 [SC21 N 4965].

8.2.3.2 New Work Items. (U) Work in SC21/WG4 on OSI management is continuing on several new parts for *Systems Management,* DIS 10164. CD text for these parts is expected in November 1990. These are [Ref. 152]:

- Part Y: *Test Management Function,* July 1990 [SC21 N 4978].
- Part Z: *Confidence and Diagnostic Test Classes,* July 1990 [SC21 N 4957].
- Part A: *Measurement Summarization Function,* July 1990 [SC21 N 4972].

New work items include:

- *Systems Management Tutorial,* July 1990 [SC21 N 4942] (planned to be a new technical report) (CCITT X.702) [Ref. 153].
- *State Tables for CMIP,* January 1990 [SC21 N 4058] (accepted by JTC1 in June 1990, but will probably not be addressed by SC21/WG4 until late 1991).
- *Software Management Function,* July 1990 [SC21 N 4976], expected to be a new part of DIS 10164 and an addendum to DIS 10165-2 (accepted by JTC1 in June 1990; CD text expected in June 1992).

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20 (U) An object in a refined class (i.e., a subclass) of a class definition (e.g., a modem) could behave in certain situations as if it were the parent. This characteristic, called polymorphism or more recently allomorphism, would support backwards compatibility. The way in which an object would respond would depend on how it is addressed. This work will lead to a change in both CMIS and CMIP.

- *Time Management: Representation of Time*, July 1990 [SC21 N 4953] (accepted by JTC1 in June 1990; expected to be a new part of DIS 10164)--deals with the distribution and synchronization of time in a distributed environment.
- *Extensioned Systems Management Architecture*, July 1990 [SC21 N 4943] (planned to be an amendment to DIS 10040).
- *Formal Descriptions of CMIP*, July 1990 [SC21 N 4947].
- *Systems Management Relationship Model*, July 1990 [SC21 N 4948]--expected to use entity-relationship modelling (planned to be a new part of DIS 10164).
- *Systems Management: Response Time Monitoring*, July 1990 [SC21 N 4949] (planned to be a new part of DIS 10164).
- *Generic Managed Objects*, July 1990 [SC21 N 4944] (planned to be a new part DIS 10164).
- *Definition of a Management Information Register and Registration Procedures*, July 1990 [SC21 N 4945]--to define a mechanism for registering system management information and procedures for maintaining the register. The Management Information Register would contain information describing:
  - Support managed object classes.
  - Generic managed object classes.
  - Definitions of attribute types, support objects, system management notifications, system management actions, name bindings, and management information parameters.
- *Requirements and Guidelines for Managed Object Conformance Statement (MOCS) Proformas*, July 1990 [SC21 N 4946]--to provide requirements and develop a standard specification technique (template) for MOCS proforma, thus helping to ensure their completeness, consistency, and ease of use. MOCS proformas are analogous to PICS proformas, but apply to managed object definitions as opposed to protocols. Designed to be an addendum to DIS 10165-4 (PDAD in 1991, DAD in 1992, and AD in 1993).
- *Management Information for the OSI Upper Layers* (approved by JTC1 in May 1990) [Ref. 154].
- *General Model for Relationship Management* to support DIS 10164-3, which addresses three methods of representing relationships: by name binding, by attributes, and by managed objects [Ref. 155].

(U) In addition, SC21/WG4 is preparing a draft technical report containing the general information generated for the five functional area documents (configuration management, fault management, accounting management, performance management, and security management). Extensions to the architecture document, *System Management Overview*, DIS 10040, include scenarios, associations (e.g., initialization),

and management of system management. Generic managed object registration and registration procedures have been accepted as a new work item. Further, SC21/WG4 will begin work on managed objects and conformance statement proforma (guidelines). Finally, SC21/WG4 will work on CMIS/CMIP in areas such as superclasses and state tables for CMIP.

8.2.3.3 Systems Management, DIS 10164. (U) DIS 10164, *Systems Management,* establishes user requirements for each management function, establishes a model that relates the services and generic definitions provided by this function to user requirements, defines the services provided, defines generic notification types and parameters documented in accordance with the guidelines for the definition of managed objects, specifies the protocol necessary to provide the service, specifies the abstract syntax necessary to identify and negotiate the functional units in the protocol (if necessary), defines the relationship between the services and SMI operations and notifications, specifies compliance requirements placed on other standards that make use of these generic definitions, defines relationships with other systems management functions, and specifies conformance requirements. DIS 10164 does not define implementation aspects, specify the manner in which management is accomplished, define interactions that result in the use of management functions, specify services for establishment and normal or abnormal release of a management association, or define managed objects.

(U) DIS 10164 defines particular systems management functions and how these are achieved by use of CMIS. ASN.1 is the notation used to express the abstract syntax of the data elements associated with managed object, attribute, event, and action definitions that shall be carried in CMIP.

(U) The major management functions addressed in SMI are defined in Table 12.

8.2.3.4 Major Remaining Issues for DIS 10164. (U) The following technical issues are not yet addressed by DIS 10164 [Ref. 156]:

- Renaming managed objects--requirements for renaming managed objects, including classes to be renamed, conditions under which rename would be permitted, constraints on renaming objects in standardized procedures, and changes that need to be coordinated to make a renaming operation consistent and meaningful.

- Service access control--mechanism to address the need for individual open systems to have the option of protecting themselves against the invocation of services that would forcibly change existing configured relationships among managed objects.
- Startup and shutdown--addressing the requirement to manage the state of an object as regards invoking startup (or initialization) and shutdown.

8.2.3.5 Structure of Management Information (DIS 10165). (U) The purpose of DIS 10165-1, *Management Information Model,* is to give structure to the management information conveyed externally by systems management protocols and to model management aspects of the related resources (e.g., an X.25 protocol machine). Managed objects are abstractions of data processing and data communications resources (e.g., protocol state machines, connections, modems) for the purposed of management. It is the attributes, operations, and notifications of managed objects that are visible to management, whereas the internal functioning of the managed object (i.e., the resource it represents) is not otherwise visible to management. DIS 10165-1 describes the model of management information in terms of managed objects and the set of operations that may be performed upon them and notifications that they may generate. It also defines, using object-oriented principles, key concepts such as inheritance, allomorphism, containment, and naming as they relate to managed objects.

Table 12. (U) Definitions of OSI Management Functions From DIS 10164

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- Object management--ability to create, delete, examine, and change sets of management information that describe parts of the OSI environment.
- State management--the ability to examine and be notified of changes in state, to monitor overall operability and usage of objects in a consistent manner, and to give or withhold permission for the use of specific objects.
- Relationship management--the ability to examine the relationships among various parts of the system, to see how the operation of one part of the system depends upon is depended upon by other parts.

  Alarm reporting function--reports alarms, errors, and related information. Malfunctions will range in severity from minor, where a minimal impact upon the quality of service to the user occurs, to major, where it is no longer possible to provide the quality of service requested (or promised to) the service user.
- Event report management--the ability to specify conditions to be satisfied by a potential event report relating to a particular managed object or a set of managed objects, in order to be sent to specified destinations.
- Log control--the ability to preserve information about events that may have occurred or operations that may have been performed by or on various objects.
- Security alarm reporting function--provides such capabilities as the means to receive notifications of security-related events, alerts of any misoperations in security services and mechanisms, alerts of attacks on system security, and information as to the perceived severity of any misoperation, attack, or breach of security. The standard provides notifications that include reporting of the clearance of fault conditions.
- Security audit trail--the ability to maintain a record of security-related events that occur in the management domain and to review and analyse these events to detect security breaches, malfunctions, and effectiveness of the security services and mechanisms that are implemented pursuant to the security policy.
- Access control--provides consistent levels of granularity necessary to a homogeneous control policy, preventing management notifications from being sent to unauthorized recipients, preventing initiators from having access to management operations, and protecting management information from unintended disclosure. Various levels of access control will be supported: some users may be given read and write access to specific attributes while other users have only read access or no access; some users may be granted access only to specific managed objects; and some users may not be allowed to establish management communications at all.
- Test Management Function--remote control of tests involving real open systems and the specification of tests that exercise OSI resources.
- Confidence and Diagnostic Test Classes--defines service in the form of test classes that are required in order to investigate the ability of a resource to perform its allotted function, the ability of the communications mechanism to make a connection between a number of open systems and to transfer data without modification between a number of open systems, the integrity of a protocol, and the effect of increased utilization of a resource.
- Measurement Summarization Function--measures throughput, time delays, message round trips, response times, and other measures of congestion and resource utilization for performance monitoring and statistics related to performance monitoring.

(U) DIS 10165-2 defines the generic object classes, support managed object classes, abstract attribute types, attributes types, notifications types, action types, parameter types, and associated abstract syntaxes that may be applicable to a number of

different standards. It also specifies compliance requirements place on other standards that make use of these definitions.

(U) DIS 10165-4 defines the management information that is to be transferred or manipulated by means of the OSI management protocol and the managed objects to which that information relates. DIS 10165-4 provides developers of managed object class definitions with the information and documentation tools that are required in order to produce complete managed object class definitions.

8.2.4 Telecommunication Management Network (TMN)

(U) The Telecommunication Management Network (TMN) is concept developed by CCITT (Recommendation M.30) to manage a telecommunication network (e.g., the public telephone network or an ISDN). A TMN is conceptually a separate network that interfaces a telecommunications network at several different points to receive information from it and to control its operations. A TMN may use parts of the telecommunications network to provide for its own communications.

(U) Architecturally, the TMN functions are divided into three blocks:

- Operation System Function (OSF) that processes the information related to telecommunication management to support or control the realization of various telecommunication management functions.
- Mediation Function (MF) that acts on information passing between Network Element Functions (see below) and OSFs to achieve smooth and efficient communication. The main MFs are communication control, protocol conversion, data handling, communication of primitives, processing involving decision making, and data storage.
- Data Communication Function (DCF) that provides the means to transport information related to telecommunication management between functional blocks.

(U) The three functional blocks can communicate with two external blocks. One is the Network Element Function (NEF) that communicates with a TMN for the purpose of being monitored and/or controlled. The other is the Workstation Function (WSF) that provides the means for communications between function blocks (OSF, MF, DCF, and NEF) and the user. The current draft of the *NATO C3 Architecture Communications Subsystem* (July 1989) indicates that the management of the NATO ISDN will be based on the TMN concept [Ref. 157].

8.2.5 Military Concerns in Network Management

(U) Some concerns in the OSI management area involve the direction and support of work being done by ISO for Quality of Service (QoS) and multipeer/multiaddressing. Both of these areas were reassessed in 1989 due to lack of support from the nations. Specifically, a formal question[21] has been raised and put to a ballot on the need for a framework for quality of service within the ISO standards. Since these areas have been found to be priority items for achieving military requirements within NATO, it is important for the nations individually and collectively to increase their support for additional work in these standards areas.

(U) The Ad Hoc Working Group on OSI Management (AHWG-OM) of TSGCEE SG9 has been formed to address OSI management issues for NATO.[22] The major standing document of the AHWG-OM is *NATO Requirements for Open Systems Management* [Ref. 158]; some key elements are the following:

- Part 1: *Rationale and Objective* (of which Section 7 is *Military Features and Their Impact on OSI Management* and Annex A.2 is the *Work Plan*), 28 June 1990
- Annex H: *Notes Concerning the Quality of Service Issue*, Third Draft, 9 February 1990
- Appendix 4, *Requirements for a Network Management Broadcast Facility*, 1 May 1990.

8.2.6 Quality of Service (QoS)

(U) In the framework of OSI, QoS provides the capability to measure the service level provided by the communications service provider and the means to request a target service from the communications service provider. QoS parameters now used in ISO standards[23] include transit delay and priority.

(U) SC21/WG1 posed Question 62 (Q62) in 1989 to query whether a QoS Architecture was necessary since such an architecture would require modification to the OSI Reference Model. The first step to developing such an architecture would be defining the components of a QoS Framework. A concern of several national bodies in

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21 (U) ISO/IEC JTC1/SC21/WG1 Question 62: "Is Quality of Service an architectural issue which needs overall guidance and consistent approach across all layers?" Balloting closed in May 1989.

22 (U) The work TSGCEE SG9 working groups is discussed in Section 10.3. The AHWG-OM is addressed in Section 10.3.5.

23 (U) ISO/IEC references to QoS are in Layer 3 (ISO 8438), Layer 4 (ISO 8072, 8073), Layer 5 (ISO 8326), Layer 6 (ISO 8822), and Layer 7 (ISO 8649, 8650, 8571-3).

WG1 is that a new QoS Architecture would destabilize the existing standards. At the May 1990 SC21 Plenary in Seoul, WG1 did not progress the QoS Framework as a new work item. WG1 reported to SC21 [Ref. 159]:

> [WG1] believes that it is still premature to progress the work any further at the current stage. The group noted that only [a] limited number of national body contributions [were] received on this question; also noted that there is not enough technical contributions and general consensus for progressing the work, although renewed expressions of interest have been received from several national bodies.

WG1 has requested additional contributions from national bodies by January 1991 on the QoS Framework.

(U) The AHWG-OM (see Section 10.3.5) has identified [Ref. 160, 161] the following deficiencies and requirements relative to QoS:

- Only static QoS parameters have been defined--the relationship of various QoS parameters to each other and actions to take upon dynamic change in QoS are not yet supported.
- A tight coupling between QoS and communications services is needed to support applications in areas such as military and real-time process control and high assurance of message delivery. Specifically, this means that applications need:
  - Capability to clearly express the QoS requirement to the underlying communications service
  - Notification of changes in QoS
  - Close monitoring of the QoS
  - Assurance that QoS is maintained in a deterministic manner.
- While the need of the layer services have led to protocol definitions that include parameters for specifying QoS, no syntax or semantic meaning of those parameters has been defined.

Further, the AHWG-OM has recommended that:

- An overall framework for OSI QoS be developed and, specifically, ISO/IEC SC21/WG1 raise the priority of QoS discussions in this area.
- QoS be expanded to provide five functions: establishment, monitoring, maintenance, notification of change, and negotiation.

- The definition of QoS be modified to include the following four classes of QoS parameters:
  - Quality of addressing--the correct assignment of addresses to the originator and the recipient.
  - Quality of message--the reliability of message delivery against data loss, data corruption or insertion, misdelivery, duplicate delivery, or out-of-sequence delivery.
  - Quality of timeliness--the delay of transferring information across a communications service, including specification of requirements on time limits for delivery of a message. The latter may be in terms of the time after which the message is no longer valid, allowable delay in the transfer, and the action to take on failure to meet the criteria.
  - Quality of confidentiality--the ability of the system to protect its resources from unauthorized use and to prevent unauthorized interception of information relative to the transfer of a message. Clearly this quality overlaps security requirements.

(U) The AHWG-OM in its meeting in June 1990 recommended three steps for progressing work on QoS: (1) establish an ad hoc working group on QoS in TSGCEE SG9 to define QoS requirements and a QoS Framework; (2) apply the QoS Framework in other SG9 working groups; and (3) provide additional information to ISO and other standards bodies on the need for QoS. AHWG-OM recommended that the proposed framework consider the application QoS parameters, the application actions (procedures used by applications in processing QoS information), and QoS facilities for establishment, monitoring, maintenance, notification, and negotiation of QoS [Ref. 162].

(U) A key background paper for QoS is *Management Requirements Arising from a NATO Study of Quality of Service* [Ref. 163]. This paper identifies QoS requirements in such areas as specification, establishment, application actions, monitoring, maintenance, notification, negotiation, information flow, and applicability. It also addresses the QoS framework, information model, and interaction model. Four QoS parameters are identified: addressing, message, timeliness, and confidentiality. The June 1990 recommendations of the AHWG-OM to SG9 were based, in part, on material described in this paper.

8.2.7 Special Interest Groups for OSI Management

(U) A number of special interest groups have been formed to promote standardization of OSI management. These include [Ref. 164]:

- Network Management Experts Group--formed within EWOS with plans to meet four times per year
- Network Management Forum (NMForum)--developing specifications that will be demonstrated in September 1990 during the first Network Management Showcase
- NIST Network Management Special Interest Group (NMSIG)--developing specifications for the *Stable Implementor's Workshop Agreements* with a target date of December 1990. The 1990 version will define, in coordination with EWOS and the NMForum, managed objects for LANs including FDDI, X.25, and ISDN. Additional managed objects would be defined in 1991 for Layer 3-7 protocols and routers and in 1992 for applications, operating systems, and database management systems.

8.3 Standards for Registration Authorities

(U) Registration provides unambiguous identification of instances of certain types of information objects within the OSI environment. Examples of these instances are an application process, an application entity, and the definition of a class of information such as a file format. Registration is the assignment of an unambiguous name to an instance of a type of information object in a way that makes the assignment available to interested parties. It is carried out by a registration agent that may be either a standard or an organization.

(U) SC21 and SG VII have agreed to collaborate in work on registration authorities. The groups have concurred that "the establishment and operation of registration is critical to communications in a distributed environment and that, without procedures for the operation of registration, interoperability between applications is unlikely" [Ref. 165]. An area of disagreement is the presence of the Name Form in DIS 9834-1, included to support the specification of procedures to ensure the assignment of unambiguous names for registration purposes.

(U) ISO JTC1 SC21/WG1 has developed[24] a standard (DIS 9834, *Procedures for the Operation of OSI Registration Authorities*) for the operation of OSI registration authorities. The status and structure of this standard is as follows:

- DIS 9834-1 (Part 1): *General Procedures*, March 1990 [SC21 N 4352]
- DIS 9834-2 (Part 2): *Registration Procedures for Document Types*, May 1988 [SC21 N 2605]
- ISO 9834-3 (Part 3): *International Register of Object Identifier Component Values for Joint ISO/CCITT Use*, 1989 [SC21 N 4718, April 1990]
- DIS 9834-4 (Part 4): *Registration of VTE Profiles*, March 1990 [SC21 N 4325]
- DIS 9834-5 (Part 5): *Registration of VT Control Objects*, March 1990 SC21 N 4322]
- DP 9834-6 (Part 6): *Registration Authority Procedures for AP Titles and AE Titles*, July 1989 [SC21 N 3185] (DIS text expected in 1990).

DIS balloting on 9834-1 was suspended and will begin again in August 1990 on recommendation to SC21 by WG6 [Ref. 166].

(U) Work in registration authorities (SC21/WG1) is ongoing in one additional area: registration of system titles, for which DP status is expected in November 1990. Prior work on authentication mechanisms, application context names, abstract syntaxes, and transfer syntaxes is now considered as not required.

8.4 Status of Standards for Conformance Testing

(U) Conformance testing is crucial to the achievement of OSI to ensure comparability of test procedures and results by different test centres. Standardization of conformance test suites needs to be based on a standard testing methodology and approach to test suite specification, which is reflected in DIS 9646, *OSI Conformance Testing Methodology and Framework*. Work has already begun in standardizing test suites based on DIS 9646 for X.25 terminals, the connection-oriented transport protocol (ISO 8073), MHS, FTAM, ACSEs, session, and presentation protocols. A detailed description of OSI conformance testing is provided in Reference 167. ISO/IEC work in conformance testing is done by SC21/WG1.

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24 (U) Work on Registration Authorities beginning in November 1989 was transferred to SC21/WG6.

(U) DIS 9646 is being developed in six parts, all of which are stable:

- DIS 9646-1, Part 1: *General Concepts*, May 1990 [SC21 N 3429] (CCITT X.290)
- DIS 9646-2, Part 2: *Abstract Test Suite Specification*, May 1990 [SC21 N 3430] (CCITT X.291)
- *Addendum to Part 2 on Testing and Formal Description Techniques (FDTs)*, DIS 9646-2 WDAD1
- DIS 9646-3, Part 3: *The Tree and Tabular Combined Notation (TTCN)*, January 1990 [SC21 N 4327] (CCITT X.292)
- *Addendum on Extensions to TTCN Including Parallel* Tree, DIS 9646-3 WDAD1, March 1990 [SC21 N 4219, December 1989]
- DIS 9646-4, Part 4: *Test Realization*, May 1990 [SC21 N 3504] (CCITT X.293)
- DIS 9646-5, Part 5: *Requirements on Test Laboratories and Clients for the Conformance Assessment Process*, May 1990 [SC21 N 3503] (CCITT X.294)
- DP 9646-6, Part 6: *Interpretation of Test Report*, 1989
- *Protocol Profile Testing Methodology*, May 1990 [SGFS N 9].

(U) There are four primary areas for standardization of conformance testing in the near future: multi-protocol (profile) testing, multi-party test methods, additional features in TTCN and multi-test case tables, and the nature of profile conformance testing and configurability [Ref. 168]. Specifically,

- *Protocol Profile Testing Methodology* is a proposal for a new work item, January 1990. This standard will supersede TR 10000-1 as far as conformance aspects are concerned. A joint meeting with CCITT SG VII is planned for February 1991; CD text as Part 7 and addenda are expected in June 1991.
- Multi-party test methods will be addenda to parts of DIS 9646. A joint meeting with CCITT SG VII is planned for February 1991, and CDAMs are expected in June 1991.
- Work on TTCN extensions has already begun. As an addendum to DIS 9646-3, *TTCN Extensions* introduces the notion of parallelism in order to ease the writing of test cases, provide a language means to describe explicitly the cooperation of (distributed) components of a test architecture, and to make TTCN a test notation that covers the aspects of a multiparty test methodology. WDAD text was distributed for comment in March 1990, and CDAD text is expected in October 1990.
- Formal methods in conformance testing is a proposal for a new work item, January 1990. A join: meeting is planned with CCITT SG X in November 1990, and CD text is expected in May 1992.

Additional topics to be addressed for conformance testing in 1991-1992 are ISDN and multimedia concerns, application of formal methods, and protocols for test support.

(U) *The Protocol Profile Testing Methodology* will extend the OSI conformance testing methodology and framework (DIS 9646) to make it applicable to OSI protocol profiles as well as base protocols.

(U) The multi-party test methods (MPTM) addenda to DIS 9646 [SC21 N 4218, January 1990] define the main requirements concerning MPTM and a multi-party test architectural model. The model will be used to map abstract test methods on which to base the development of abstract test suites and means of testing for the various multi-party protocols and multi-party testing configurations using more than one protocol or more than one channel.

(U) SC21/WG1 has noted concerns [Ref. 169] about the available resources and direction of work on upper layer conformance testing. Work has slipped 2 years on abstract test suites for FTAM and 3 years for embedded test suites for ACSE, Presentation Layer, and Session Layer. There is an imbalance between work on the basic methodology and that applied to the actual conformance tests, specifically on abstract test suites.

(U) EWOS has agreed [Ref. 170] to convene an activity to study and investigate OSI Conformance Testing Methodology. This work would examine central aspects of OSI testing methodology that are necessary to support standardization of test specifications. CEN has been assigned leadership of the work.

(U) TTCN is a unique, informal notation that was developed by ISO and CCITT for specifying generic and abstract test cases [Ref. 171]. Other formal description techniques in use for this purpose are the Language of Temporal Ordering of Specification (LOTOS) and Estelle--both accepted in the *NTIS Transition Strategy*--and the System Development Language (SDL), developed by CCITT (Recommendation Z.100). Both Estelle and SDL are Pascal-based notations. These formal description techniques (FDTs) are described in detail in Section 8.5.

(U) TTCN provides a notation in which generic and abstract test cases can be expressed in test suite standards, which is independent of test methods, layers, and protocols, and which reflects the abstract testing methodology of DIS 9646. TTCN provides a naming structure to reflect the position of test cases in the abstract test suite hierarchy (complete test suite, test groups, test cases, test steps, and test events). TTCN also provides the means of structuring test cases as a hierarchy of test steps culminating in test events.

(U) An approach used in conformance testing (and in other applications) to specify interoperability parameters for an implementation (or a functional profile) is called a protocol implementation conformance statement (PICS). A PICS specifies all the parameters and options required to show how a particular implementation meets static conformance requirements. As such, it is the first tool in conformance testing. A PICS proforma is a PICS template developed and standardized in conjunction with a protocol standard. TSGCEE SG9 will use the PICS proforma as part of the functional profile guidelines.

(U) Many organizations have been formed to address OSI conformance testing. These include Corporation for Open System (COS), SPAG, European Committee for Standardization (CEN)/European Committee for Electrotechnical Standardization (CENELEC), NIST, Industrial Technology Institute (ITI), World Federation of Manufacturing Automation Protocol (MAP) and Technical and Office Protocol (TOP) User Groups, Conformance Testing Services-Wide Area Network (CTS-WAN), National Computing Centre (NCC), and EurOSInet. TSGCEE SG9 is addressing [Ref. 172] NATO requirements in this area and whether NATO-specific activities need to be supported. The following are areas in which existing civil organizations may be expected to contribute to conformance testing to support NATO requirements [Ref. 173]:

- Developing standards and conformance certification criteria: ISO, CCITT
- Developing abstract test suites for OSI upper layers: ISO
- Developing test profiles and provisioning testing under military requirements: COS, SPAG
- Developing site accreditation criteria: Industrial Technology Institute (ITI)
- Implementing site accreditation and testing tools, and specifying test control and maintenance procedures: NIST
- Developing standards and test methodologies: CEN/CENELEC, ANSI.

(U) COS [Ref. 1742] and SPAG have now completed formal agreement to combine their conformance test products within a single integrated tool set (ITS). In addition, COS, POSI, and SPAG have completed (June 1989) an Initial Strategic Technical Cooperation Agreement that commits the organizations to a strategic cooperative arrangement designed to provide a common technical solution to conformance testing, building upon the ITS. The agreement is also known as "CPS" (both for Conformance Promotion Strategy and for COS-POSI-SPAG).

8.5 Formal Description Techniques (FDTs)[25]

(U) FDTs are used to produce unambiguous descriptions of OSI services and protocols in a more precise and comprehensive way than natural language descriptions. Further, FDTs provide a foundation for analysis and verification of a description. The objectives of FDTs are to provide:

- Unambiguous, clear, and concise specifications
- Basis for determining completeness of specifications
- Foundation for analysing specifications for correctness, efficiency, etc.
- Basis for determining consistency of specifications relative to each other
- Basis for implementation support.

(U) There are three international standard FDTs that range from abstract to implementation-oriented: Estelle, LOTOS, and SDL. Since emerging standards are being written in one or more of these FDTs, the following sections are provided to give some technical information, together with the basis, derivation, and character, for these description techniques [Ref. 175]. DTR 10167, *Guidelines for the Application of Estelle, LOTOS, and SDL,* SC21 N 4259, January 1990, provides guidelines for applying these three FDTs. A fourth FDT--TTCN--was described in Section 8.4.

(U) SC21/WG1 has developing a working draft for *Architectural Semantics for FDTs* [SC21 N 4231, April 1990]. This work was planned to assist development of formal descriptions of standards for data communications, networking, and distributed computing. The draft defines and catalogues a set of selected elementary concepts, which act as a bridge between the architectural concepts and structures and the semantic models of the FDTs (Estelle, LOTOS, and SDL). SC21 approved the May 1990 recommendations developed by a reassessment of the work associated with the *Architectural Semantics for FDTs*. The current work in SC21/WG1 will be terminated and a subproject initiated in SC21/WG7 in the area of ODP architectural semantics [Ref. 176].

8.5.1 Estelle

(U) Estelle (ISO 9074, *Estelle, A Formal Description Technique Based on an Extended State Transition Model,* July 1989) is a formally-defined specification language for describing distributed or concurrent processing systems, in particular those that implement OSI services and protocols. The language is based on widely used and

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25 (U) Discussion of FDTs is taken, in part, from DTR 10167, *Guidelines for the Application of Estelle, LOTOS, and SDL.*

accepted concepts of communicating non-deterministic state machines (automata). An Estelle specification defines a system of hierarchically-structured state machines. The machines communicate by exchanging messages through bidirectional channels connecting their communications ports. These messages are queued at either end of the channel. The actions of machines are specified in (extended) Pascal; hence, familiarity with Pascal makes Estelle specifications easily readable. Estelle uses Pascal data types in its data descriptions.

(U) Estelle is based on an extended state transition model, i.e., a model of a nondeterministic communicating automaton extended by the addition of the Pascal language. Estelle may be view as a set of extensions to Level 0 of ISO 7185 (*Programming Language - Pascal*) that models a specified system as a hierarchical structure of communicating automata that may run in parallel and may communicate by exchanging messages and by sharing, in a restricted way, some variables. As in Pascal, all manipulated objects are strongly typed, which enables static detection (e.g., during compilation) of specification inconsistencies.

(U) Estelle language mechanisms allow modelling of synchronous and asynchronous parallelism between state machines of a specified system. They also permit dynamic development of the system configuration. Estelle specifications can be prepared at different levels of abstraction, from abstract to quite implementation-oriented. The latter may be derived from the former with the aid of supporting tools. An Estelle tutorial has been developed and is intended to become Annex D (informative) of the Estelle base standard (ISO 9074 PDAD1, *Estelle Tutorial*, SC21 N 4230, December 1990).

8.5.2 LOTOS

(U) LOTOS (ISO 8807, *LOTOS, A Formal Description Technique Based on the Temporal Ordering of Observational Behaviour*, February 1989) is a mathematically-defined FDT, developed from a large, well-established body of theory based on three mathematical techniques: Calculus of Communicating Systems (CCS), Communicating Sequential Processes (CSP), and ACT ONE. Having a well-defined mathematical foundation, it provides a solid basis for both analysis and development of reliable tools, including simulation, compilation, and test sequence derivation. The basic constructs of LOTOS allow modelling of sequencing, choice, concurrency, and nondeterminism in an entirely unambiguous way. In addition, LOTOS permits modelling of both synchronous and asynchronous communication. LOTOS, like SDL, uses abstract data types in its data descriptions.

(U) LOTOS may be applied to produce a specification of the allowed behaviours of a system, i.e., the set of all behaviours that may be observed of a

conforming implementation. Furthermore, LOTOS permits the description of allowed behaviours without describing how this may be achieved or by describing particular mechanisms that achieve the required behaviour.

(U) Formal descriptions of the session service and protocol using LOTOS have been developed:

- TR 9571, *LOTOS Description of the Session Service*, September 1989
- TR 9572, *LOTOS Description of the Session Protocol*, September 1989.

8.5.3 SDL

(U) SDL is based (CCITT Z.100-Series recommendations) on the extended finite state machine model supplemented by capabilities for abstract data types based on the initial algebra model (the same one used in the ACT ONE part of LOTOS). This combination is supported by well-defined formal semantics. SDL provides constructs to present structures, behaviours, interfaces, and communications links. In addition, it provides constructs for abstraction, module encapsulation, and refinement. All of these constructs were designed to assist the representation of a variety of telecommunications systems specifications, including aspects of protocols and services.

8.5.4 G-LOTOS

(U) Text for a standard for a graphical syntax, G-LOTOS, has been submitted [Ref. 177] that provides an extension to LOTOS (ISO 8807) to facilitate production and enhance clarity and readability of formal descriptions, simplify teaching and learning the language, favour the development of advanced user-friendly software tools, and promote the diffusion and application of the language [Ref. 178].[26]

26 (U) New work item [JTC1 N 485] for G-LOTOS was not accepted; status of PDAD1 is uncertain (April 1990).

9. STANDARDS FOR ENHANCED INTEROPERABILITY

(U) Previous chapters have identified technical standards needed to achieve basic interoperability, which is defined as the exchange of information that preserves meaning and relationships. Chapters 4-7 reviewed standards applicable to one of the four basic facilities, and Chapter 8 addressed standards applicable to all four basic facilities. This chapter summarizes standards and technical approaches to selecting interoperability parameters from standards that would go beyond basic interoperability and beyond the four Basic Facilities that support basic interoperability.

9.1 Enhanced Interoperability

(U) Enhanced interoperability includes all the functionality required to provide basic interoperability, together with additional functionality and characteristics. Standards for enhanced interoperability would go beyond those required for ATCCIS-conformant systems and would require additional agreements. Examples of enhanced interoperability would be application-level facilities (ALFs) for performing certain key tasks, a human-computer interface service facility, a user-interface management system (UIMS), and specialized input-output facilities (IOFs). These are discussed in WP 24.[27]

9.2 Standards for Enhanced Interoperability

(U) There is a potential for cost savings and improved interoperability if standards are adopted for use by two or more nations in ATCCIS-conformant systems. These standards could be in the areas of operating systems, human-computer interfaces, database management, graphics interchange, document interchange, and programming services (e.g., languages for software development). Use of such standards can lead to portable application software for use in more than one type of ATCCIS-conformant system, not only to implement applications that go beyond basic interoperability, but also to achieve basic interoperability in a more cost effective way.

(U) In April 1988, JTC1 of the ISO/IEC began a formal Technical Study Group (TSG-1) for Interfaces for Applications Portability (IAP). Managed directly under the JTC1, and not any of the subcommittees, the IAP study will identify user requirements and standards needed to support those requirements. The TSG-1 will address several aspects of portability, including moving applications across a range of machines, minimizing

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[27] (U) WP 24 refers to the human-computer interface service facility as the Man-Machine Interface (MMI) Service Facility (MSF).

training and simplifying user interfaces (user portability), recognizing different underlying philosophies/architectures, and distinguishing among possible levels of portability.

(U) ISO has recognized that standardization is needed for information processing that goes beyond data communications services and protocols. As will be shown in the sections that follow, there are major efforts under way in the areas of standard interfaces to operating systems, databases, graphics, user input and display devices, and programming languages. In addition, open systems standards are being developed for document interchange and distributed processing.

(U) SC21 has identified [Ref. 179] the need to provide standardization in areas related to both basic and enhanced ATCCIS interoperability. These areas are:

- Information exchange
- Internetworking of systems
- Specification of functions needed in systems built for specific purposes
- Portability of applications across system hardware and software
- Definition of common interfaces to system services
- Security of systems
- Reliability of systems
- Human/computer (man/machine) interfaces
- Definition of common concepts
- Safety and legal requirements.

SC21 specifically plans to address standardization for database management systems and single and distributed processing environments, in addition to open systems interconnection.

9.2.1 Operating System Standards

(U) When common operating systems are used, there is a potential to reduce the development of ATCCIS system elements by sharing software. Even when different operating systems are used, adoption of operating system interface standards can increase application software portability. In ATCCIS, the recommended approach would be to agree on a standard operating system interface (i.e., POSIX), but *not* to seek agreement on a standard operating system. Operating system interface standards (specifically POSIX) are discussed in Sections 5.2 and 5.3. Standards for applications portability are addressed in Section 9.4 below.

(U) SC21 has begun work in the area of Operating Systems Command and Response Language (OSCRL). A draft proposal for OSCRL is planned, but has not yet been promulgated.

(U) Two communities of operating systems standards have received strong support from vendor groups promoting application portability. One group is UNIX International (formerly Archer, with a membership of 42 corporations and user groups), which promotes UNIX System V, a proprietary standard of AT&T. Availability of Release 4.0 of UNIX System V was announced at the UNIX EXPO (November 1989) and is now commercially available. This release aims to:

- Merge all the major versions of the UNIX operating system (i.e., the /usr/group Xenix, the Berkeley 4.x BSD, and the Sun Operating System)
- Enhance data networking with the addition of Remote File Systems and Remote Procedure Calls
- Address real-time applications and environments
- Ensure conformance to POSIX through enhanced signal handling, multiple groups and ownership, and job control
- Achieve and maintain full compliance with the X/OPEN CAE.

(U) The other major group promoting operating systems is the Open Software Foundation, which has adopted the IBM AIX Version 3 of UNIX. This version conforms to POSIX, and future releases will comply with Issue 3 of the X/Open Portability Guide (XPG3). IBM intends to support both TCP/IP and OSI protocols that will operate over various physical connections (to include X.25). Other features of this operating system are the provisions for network management functions via OSI's Common Management Information Service/Protocol (CMIS/CMIP), electronic mail via X.400, and presentation services via X Windows [Ref. 180].

9.2.2 Terminal and Human-Computer Interface (HCI) Standards

(U) Human-computer interfaces comprise two levels of standardization. One level is the specification of how computer system elements shall interface to display terminals, workstations, and other output devices for which there is capability for human interaction. The second level is the look, feel, and layout of the display screens, keyboards, and other elements of the workstation that would define the way information is displayed and how the user interacts with the information provided. In ATCCIS, the recommended technical approach is to standardize the interfaces. This is

distinct from the military necessity of standardizing information formats and presentations at workstations for operational reasons.

9.2.2.1 HCI Work in ISO. (U) The standards work in ISO/IEC covers both levels of HCI. These standards activities seek to:

- Provide consistency--in screen and keyboard layout, terminology, semantics, user action, and syntax--across and within manufacturers, systems, and applications
- Enhance comfort and well-being
- Enhance usability[28]
- Assist in product procurement and evaluation.

Specifically, ISO/IEC JTC1 SC18 (Text and Office Systems) has a working group, WG9 (User System Interfaces and Symbols), that is developing standards to support keyboard layout, user interfaces, cursor control, and icons (e.g., symbols) to be displayed. In addition, the Ergonomics Technical Committee (TC159) of ISO is addressing, through SC4 (Signals and Controls) and WG5 (Software Ergonomics and Man-Machine Dialogue), standards for dialogue interface, coding, formatting, menus, and usability assurance. Other areas of standardization related to the user interface to information systems being addressed by ISO are [Ref. 181]:

- Documentation (JTC1 SC7/WG2)
- Software quality characteristics (JTC1 SC7/WG3)
- Text interchange (JTC1 SC18/WG4)
- Terminal management (JTC1 SC21/WG4)
- Form Interface Management System (JTC1 SC22)
- POSIX (JTC1 SC22/WG15)
- Commands for Interactive Text Searching (TC46/SC4)
- Software quality assurance (TC176 SC2/WG5).

9.2.2.2 Visual Display Terminal. (U) SC18/WG9 seeks to develop a User Interface Standard that would address names of basic objects and actions, user guidance, dialogue interaction, and graphical symbols used on screens. A working draft of part of this standard is planned for 1989 and an initial draft proposal for 1990. TC159 SC4/WG5 is developing a standard (DIS 9241) for VDTs that addresses office task

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28 (U) As used in SC18/WG5, usability of a product is defined as the degree to which specific users can achieve specified goals in a particular environment effectively, efficiently, comfortably, and in an acceptable manner.

requirements, visual requirements, keyboard ergonomics, work place design and environment, surfaces and filters, use of colour and graphics, non-keyboard input devices, usability, coding, formatting, and terminology.

9.2.2.3 Virtual Terminal (VT). (U) VT standards (ISO 9040 and 9041) define a communications protocol between a terminal and its host in terms of a conceptual terminal, where the mapping from the conceptual terminal to the physical device is an implementation issue outside the standard. Several classes of display and data manipulation capabilities will eventually be addressed by VT standards [Ref. 182]:

- Basic class, for textual data in a rectangular array of character boxes
- Forms class, similar to the basic class, but with the ability to define fields with control over data entry
- Graphics class, for geometric data such as lines and circles (as defined, for example, in GKS)
- Text class, for structured data such as provided by ODA data streams
- Image class, for bit-mapped displays.

(U) The initial VT standards address the basic class of capabilities. They will contain addenda that provide extensions (AD1, *Extended Facility Set*) to the basic class for enhanced access rules, structured control objects, blocks, fields, and reference information objects. These enhancements will be incorporated into the base text before the standards are submitted for ballot as international standards. Three additional extensions are being developed [SC21 N 3366 and N 3367, December 1988] for VT: ripple, to provide facilities to undertake simple text editing by the addition of control objects and operations; exception reporting for non-fatal errors; and context retention for multiple VT sessions. These extensions are being progressed as Addendum 2 (DAM2, *Additional Functional Units*) to both ISO 9040 and 9041. CD 9041-2, *VT PICS Proforma,* is planned for June 1991. SC21/WG5 expects DIS text for the PICS Proforma to be available in November 1992. In addition, registration authority procedures are being developed for the Virtual Terminal Environment (VTE) and VT Control Objects: DIS 9834-4 and DIS 9834-5, respectively. Finally, a guide to VT standards has been developed by SC21/WG5 [SC21 N 3365, December 1988]. A draft *Conformance Test Suite for the VT Protocol* [SC21 N 4161] has also been developed.

(U) DAM2 [SC21 N 5031, May 1990] for ISO 9040/9041 enhances the capability of the VT environment by use of the Association Establishment or Negotiation functions, extends the set of objects and operations provided by the Data Transfer function, and enhances error handling capabilities of the service provider. DAM2 provides additional functionality for ripple mode editing (insertion, deletion, and copy

operations for a Display Object), exception reporting (provides mechanisms by which non-fatal exception conditions may be reported by the VT service provider to VT users), and retention of VT context across Negotiation (retention of the information stored in selected VT Objects--Display Object and Control Objects--to be retained between successive VT environments within the life time of a VT association).

(U) VT profiles are being developed by two regional workshops: the European Workshop for Open Systems (EWOS) and the NIST OSI Implementor's Workshop. EWOS is working on synchronous-mode profiles that are based on a two-way exchange with a single display object requiring the exchange of an access token. EWOS profiles include Forms, Page, Enhanced, and Enhanced Page. The NIST Workshop is developing asynchronous-mode profiles. These are based on a character-by-character interworking, in which there are two display objects, but the user at each end is allowed to update only one of the objects. NIST Workshop profiles include TELNET, Transparent, Forms, Scroll, Page, and X29 (of which the first three are in the Stable Agreements).

9.2.2.4 Terminal Management (TM). (U) SC21/WG5 is working on a program for developing standards for TM, directed at support for multi-function workstations. The role of TM is to support the control and manipulation of logical devices typically associated with workstations. Logical devices are defined in TM to provide a mapping between transferred data such as ODA documents and the physical devices such as a workstation screen, taking into account control information such as synchronization and the use policy of a particular application. TM is related to Document Transfer and Manipulation (DTAM, CCITT), user interface standards (SC18), Forms Interface Management System (FIMS, SC22), and window management (SC24). The TM standard consists of three parts: *TM Model* (CD 10184-1), *TM Service* (WD 10184-2), and *TM Protocol* (WD 10184-3). The first, *TM Model*, progressed to CD status in April 1990. CD status for the other two is expected in July 1991 [Ref. 183].

(U) TM provides a general framework for defining interactive processes that support in a systematic way such diverse features as: (1) combining different data types (e.g., presenting diagrams with a telephone conversation); (2) handling multiple simultaneous dialogues from a single terminal, and (3) interacting with several levels of processes in a single session, in which low-level functions such as echoing and simple checking are done locally and responses to more demanding operations such as

database access are generated by a remote system. The TM draft standards address the following requirements [Ref. 184]:

- Presenting data from several sources on a single display, for example using a window system.
- Moving data between windows presented together.
- Supporting multiple users and displays attached to one application.
- Handling the same data at several different levels of abstraction; for example, a graphics image may need to be manipulated at the level of a display list, at the level of various geometric objects, or at the bit-map level.
- Controlling how the logical structure of dialogues is mapped onto real resources, such as open systems and OSI application associations.

(U) TM permits the establishment of a general network of processes with dialogues between them. The dialogues may be of a variety of types, such as VT, bit-map graphics, or ODA. TM does not itself define the operation of an individual process, nor does TM define the data stream for a particular dialogue type--these are specified by other standards. Where a process has input parameters that may be adjusted, such as the specification of the positions and priorities of the various windows in a window system, these are provided by TM. The TM model addresses the following:

- Model for Terminal Management Application Service Elements (ASE) in two or more open systems that collectively are defined as a Terminal Management Domain (TMD)
- Model for the information flows between ASEs within a TMD
- Model for the shared use of interactive resources within a TMD
- Mechanisms for the representation of information in a window environment
- Relationships between the Terminal Management ASE and other ASEs within a Single Association Control Function
- Relationship between the Terminal Management ASEs and other ASEs within the Multiple Association Control Function.

(U) A User Descriptor Object (UDO) is defined in TM; the UDO is updated and maintained by a TM control process within a TM domain. The UDO supports the following mechanisms and requirements:

- End-user specific libraries
- User Interface Management System (UIMS) tool kits

- Local system characteristics such as devices supported, window management system information in support of specific menus and icons, peripherals to be supported during a given instance of communication, and a user clipboard for the storage of miscellaneous information
- Application-specific information (known to the user)
- Window management system and user interface dependencies, such as sizing a user interface to fit window instructions
- State information for devices supported, UIMS in general, and active and de-activated applications.

(U) TM contains a User Window Manager Interface onto which users may interface their own window manager. If a user-supplied window manager is in place, all user requests are first sent to the user window manager. In cases where the user window manager makes decisions in conflict with the TM domain user policy, these are resolved within the TM process.

9.2.2.5 Status of X-Windows. (U) The X-Windows standard effort, a UNIX-based user interface standard, began as a *de facto* standard developed at the Massachusetts Institute of Technology (MIT). It was developed by Project Athena and the Laboratory for Computer Science at MIT with funding and participation by Digital Equipment Corporation (DEC) and IBM [Ref. 185]. Currently in Version 11 (Release 3), X-Windows sets a standard to provide portability of information across different hardware and operating systems. In contrast to the kernel-based architecture of traditional windowing systems, it has a network-based architecture. *User Interface*™ is based on this standard as is *DEC windows* ™ software from DEC.[29]

(U) The strategic direction in ISO OSI for support of windowing environments is Terminal Management. However, there is a rapidly growing demand for the use of the X-Windows System. This demand is being satisfied by the use of X-Windows clients and servers co-located in the same machine or over LANs using protocols such as TCP/IP. Some large user communities are now trying to run X-Windows over WANs and in some cases may plan to install TCP/IP networks in competition with the emerging OSI networks based on ISO protocols [Ref. 186].

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29 (U) See "DEC Opens an X Window for Control Systems," J. M. Stoffel, *Control Engineering*, Vol. 36, No. 4, April 1989, and "OSF Motif, the User Interface Standard," H. Oldenburg, IEEE Colloquium on User Interface Management Systems, *Digest*, No. 135, Issue 2, IEEE, 17 November 1989.

(U) Three options are being considered by ANSI Committee X3H3.6 for developing an efficient OSI compatible way of supporting the X-Windows System in an OSI environment:

- Map X-Windows directly onto the Layer 7 ACSE.
- Map X-Windows directly onto a Connection-Oriented Transport Service.
- Rewrite X-Windows completely, removing the session and presentation functionality it concurrently contains. Map X-Windows onto ACSE properly using all the facilities that can be provided by Layer 7 services.

While the last option is preferable from the standards point of view, it would require developmental effort and dedicated expertise that does not appear to be available. Further, by the time any such standard becomes complete, it would likely be too late to gain acceptance. The advantage of the first two approaches is that each recognizes the large body of user pressure that might well precipitate a non-OSI solution before the Terminal Management standard becomes available.

(U) Because Version 11 of X-Windows (X11) has limited two-dimensional (2D) graphics capabilities, a consortium of organizations under the auspices of MIT has developed X3D-PEX, an extension to the X11 standard that supports the Programmers' Hierarchical Interactive Graphics System (PHIGS) and the three-dimensional version of the Graphical Kernel System (GKS-3D) [Ref. 187]. PHIGS and GKS are discussed in Sections 9.2.3.5 and 9.2.3.3, respectively.

(U) Despite competition from other UNIX-based windowing systems like Sun Microsystems' *News*™, *Silicon Graphics*™, *4 Sight*™, and Carnegie-Mellon's *Andrew*™ [Ref. 188], X-Windows has received rapid and overwhelming acceptance as an industry standard [Ref. 189]. X-Windows is the subject of NIST, IEEE, and ANSI standards projects. FIPS-158, *X-Window User Interface,* was approved in May 1990 as a US mandatory standard. It comprises the first three layers (Layers 0-2) of the User Interface Reference Model developed by NIST [Ref. 190]. The NIST Model consists of:

- Layer 0: Data Stream Encoding
- Layer 1: Data Stream Interface (Xlib)
- Layer 2: Subroutine Foundation (Xt Intrinsics)
- Layer 3: Toolkit
- Layer 4: Dialogue
- Layer 5: Presentation
- Layer 6: Application.

(U) Layer 0 is an X- Protocol for messages between client and server. It equates with ANSI X3H3.6 (Window Management) Project 0672-D, "X Data-Stream Encoding for Window Management X Window System VII Data Stream Definition." The target date for completion of this standard is the second quarter of 1991. Layer 1 is a library interface that provides a C language interface to the X-Protocol. Layer 2 consists of basic functions for controlling windows and acts as a tool kit for building tool kits [Ref. 190].

(U) An IEEE P1201 Reference Model, which is built on the NIST Reference Model relates X, 1201 work, and other systems. IEEE Project P1201.4, "X Library" (Layer 1 of the NIST Model) is expected to go to direct ballot in 1990 using a forthcoming draft from the MIT X-Windows group. Xt Intrinsics (Layer 2 from the NIST Model above) may be taken on by IEEE P1201, but a formal proposal has not yet been made for this work.

(U) NIST Reference Model Layers 3 through 5, while not part of FIPS-158, are the subject of IEEE projects. Layer 3 is equivalent to IEEE Project 1201.1, "Toolkit--High-Level Windowing Applications Program Interface." It is the application-level interface for higher level functions. Layers 4 and 5 are addressed respectively by the User Interface Language and User Interface Management Systems work of IEEE Project 1201.3 and are still in the research stage. IEEE has formed a study group, but not a working group, for this work.

(U) The Graphical User Interface is part of the IEEE P1201 Reference Model but is not included in the NIST Reference Model. The Graphical User Interface is the subject of IEEE Project 1201.2, "Drivability Guide," which provides a recommended practice for minimal commonality for window systems (see Table 15 in Section 9.4.4.2). It uses the analogy of controls for driving a car [Ref. 190].

9.2.3 Graphics Interchange Standards

(U) This section reviews standards being developed in ISO/IEC, CCITT, and the nations for computer graphics. These include the Computer Graphics Reference Model, Computer Graphics Metafile (CGM), Graphics Kernel System (GKS), Computer Graphics Interface (CGI), Programmer's Hierarchical Interactive Graphics System (PHIGS), and the Initial Graphics Exchange Specification (IGES).

9.2.3.1 Computer Graphics Reference Model. (U) The Reference Model for Computer Graphics[30] defines a basic architecture and consistent terminology for computer graphics. It addresses environment; primitives; geometry, attributes, and aspects of primitives; pictures; collections; metafiles; and archives. There are four environments: application (to which an application interfaces), virtual, logical, and physical (to which the user interfaces) [Ref. 191].

9.2.3.2 Computer Graphics Metafile (CGM). (U) CGM standards provide a file format suitable for the storage and retrieval of picture information. The file format consists of a set of elements that can be used to describe pictures in a way that is compatible between systems of different architectures and devices of differing capabilities and design. ISO 8632 is a standard for producing a CGM in order to:

- Allow picture information to be stored in an organized way on a graphical software system
- Facilitate transfer of picture information between different graphical software systems
- Enable picture information to be transferred between graphical devices
- Enable picture information to be transferred between different computer graphics installations.

(U) The CGM standards are:

- ISO 8632-1, *Functional Specification*
- ISO 8632-2, *Character Encoding*
- ISO 8632-3, *Binary Encoding*
- ISO 8632-4, *Clear Text Encoding*.

9.2.3.3 Graphics Kernel System (GKS). (U) The GKS standard, ISO 7942, specifies a language-independent nucleus of a graphics system. For integration into a specific programming language, GKS is embedded in a language-dependent layer obeying the particular conventions of that language. This layer (technically referenced as a "binding") has been defined for the programming language Ada in ISO 8651-3, based on the Reference Manual for the Ada Programming Language (ISO 8652). It has also been defined for the programming languages FORTRAN (ISO 8651-1), Pascal (ISO 8651-2), and C (WD 8651-4).

(U) A 3D version of GKS is being developed in ISO. The purpose of GKS-3D is to specify extensions to GKS for defining and viewing 3D wire-frame objects.

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30 (U) This model does not appear to have been published as an ISO standard.

As such, the GKS-3D documents only describe additions to be made to GKS. The GKS-3D portions of the GKS standards are:

- ISO 8805, *GKS for Three Dimensions (GKS-3D) Functional Description*, October 1988, and ISO 8805/WDAD1, Addendum 1: *Name Set Addendum*, April 1987
- DIS 8806-1, GKS-3D Language Bindings - Part 1: *FORTRAN*, November 1988
- DIS 8806-3, GKS-3D Language Bindings - Part 3: *Ada*, 1989
- DIS 8806-4, GKS-3D Language Bindings - Part 4: *C*, 1989
- ANSI X3.122.5, *GKS-3D Language Bindings - LISP*.

(U) One of the major design goals in ISO is compatibility between GKS-3D and GKS. The 2D primitives of GKS can be seen as a subset of the 3D primitives obtainable via GKS-3D. This allows a GKS-3D program to read both 2D and 3D metafiles (by forcing 2D primitives to the z=0 plane); however, GKS is unable to use 3D metafiles. Thus, upwards compatibility has been achieved but not downwards compatibility.

9.2.3.4 Computer Graphics Interfacing (CGI). (U) The ISO/IEC approach to defining a CGI is provided in the document, "Interfacing Techniques for Dialogues with Graphical Devices" (CGI) [SC21 N 1179]. The governing standard is DIS 9636, which has the following parts:

- Part 1: *Overview, Profiles, and Conformance*
- Part 2: *Control, Negotiation, and Errors*
- Part 3: *Output and Attributes*
- Part 4: *Segmentation*
- Part 5: *Input and Echoing*
- Part 6: *Raster*
- Part 8: *FORTRAN Language Binding of CGI* (working draft)
- Part 11: *C Language Binding of CGI* (working draft).

9.2.3.5 Programmer's Hierarchical Interactive Graphics System (PHIGS). (U) The following are the standards for PHIGS, defining language bindings for graphics interfaces:

- ISO 9592-1, *PHIGS* - Part 1: *Functional Description*
- ISO 9592-2, *PHIGS* - Part 2: *Archive File Format*
- ISO 9592-3, *PHIGS* - Part 3: *Clear-Text Encoding of Archive File*

- ISO 9593-1, *PHIGS Language Bindings* - Part 1: *FORTRAN Binding*
- DIS 9593-2, *PHIGS Language Bindings* - Part 2: *Extended Pascal*
- DIS 9593-3, *PHIGS Language Bindings* - Part 3: *Ada*
- DIS 9593-4, *PHIGS Language Bindings* - Part 4: *C*.

9.2.3.6 Initial Graphics Exchange Specification (IGES). (U) The IGES, Version 4.0, is an ANSI standard (Y14.26M-1989) developed by the American Society for Mechanical Engineers (ASME). It establishes information structures to be used for the digital representation and communication of product definition data used by various Computer Aided Design and Computer Aided Manufacturing (CAD/CAM) systems. ASME is currently working on Version 5.0.

9.2.4 Geographic Information Exchange and Data Compression Standards

(U) This section covers the US military and government, foreign, and commercial standards and standardization activities in geographic information exchange and data compression. Digital cartographic and geographic information systems have existed for several years, however their widespread use has been impeded by difficulties in data collection and the need for information sharing standards. Perhaps the most fundamental distinction between the digital representation of cartographic data and the conventional printed graphic is the need to explicitly and unambiguously code the attributes and spatial relationships among the various data elements. Because of the massive amounts of information that must be stored, data compression is a related topic of interest.

(U) There are four basic types of digital cartographic and geographic data:

(1) Digital elevation data

(2) Digital planimetric data

(3) Digital land use and land cover data, and

(4) Digital geographic names data.

(U) Several United States Geological Survey (USGS) circulars cover these types of data:

- FIPS Pub 70-1, *Specifications for Representation of Geographic Point Location for Information Interchange* (1986) [USGS Circular 878-B]
- FIPS Pub 103, Codes for Identification of Hydrologic Units in the US and the Caribbean Areas (1983) [USGS Circular 878-A]
- USGS Circular 895-B - *Digital Elevation Models*

- USGS Circular 895-C - *Digital Line Graphs from 1:24,000 Scale Maps*
- USGS Circular 895-D - *Digital Line Graphs from 1:2,000,000 Scale Maps*
- USGS Circular 895-E - *Land Use and Land Cover Digital Data*
- USGS Circular 895-F - *Geographic Names Information System.*

(U) FIPS PUB 70-1 specifies a uniform format for representing geographic point location data in digital form for purposes of information interchange among data systems. It applies only to the three coordinate systems most widely used in the United States to define the position of a point that may be on, above, or below the earth's surface.

(U) FIPS PUB 103 adopts the set of codes used to identify hydrologic units published in Geological Survey Circular 878-A. These codes identify a hydrologic system that divides the United States and Caribbean outlying areas into 21 major regions. These regions are further subdivided into approximately 2150 units that delineate river basins having drainage areas usually greater than 700 square miles. The codes provide a standardized base for use by water-resources organizations. The UK MoD has related standards, *Digital Terrain Elevation Data* and *Digital Feature Analysis Data.*

(U) Several US military specifications also cover digital geographic information exchange:

- MIL-D-89000, *Digital Terrain Elevation Data*
- MIL-D-89005, *Digital Feature Analysis Data*
- MIL-A-89007, *Arc Digitized Raster Graphics.*

(U) The NATO Standardization Agreements (STANAG) relevant to this area include:

- STANAG 3809, *Digital Terrain Elevation Data Exchange Format*
- STANAG 3985, *Preferred Magnetic Tape Standards for the Exchange of Digital Geographic Information*
- STANAG 3986, *Digital Data File Transmittal Form for Geographic Information.*

9.2.4.1 Digital Geographic Information Exchange Standard (DIGEST). (U) The 10-nation Digital Geographical Information Working Group (DGIWG) is working on DIGEST and is expecting to submit it to NATO to become a STANAG. DIGEST may be submitted to ISO, but there is no definite plan for this. The present concern is for magnetic tape exchanges, with electronic communications exchanges possible in the future. The position of the DGIWG is that DIGEST is intended for standardizing exchanges of data between map-producing agencies, such as the Defense

Mapping Agency (DMA), and not between operational units. Standards governing exchanges between field systems are the responsibility of the system development organization. This is a traditional view in military systems development organization, and leads to substantial interoperability problems, particularly intra-national. The official position notwithstanding, the DGIWG is encouraging the distribution of DIGEST by its member nations to the widest possible audience, including the services and civilian users.

9.2.4.2 Vector Product Standard (VPS). (U) This standard is currently in a prototype stage, but nearing finalization. A military standard is expected to be issued in early 1991. Although the standard is being distributed to the civilian community, there are currently no plans to offer VPS as a civilian standard.

9.2.4.3 Spatial Data Transfer Specification (SDTS). (U) The United States National Committee for Digital Cartographic Standards, a multi-agency working group headed by the USGS which is responsible for most of the US non-military geographic information exchange standards has issued SDTS. The DMA was an original participant in the development of this standard, but dropped out in favor of its own activities. SDTS is expected to become a FIPS in mid 1991. Other standards under development by USGS include:

- Aquifer names and geologic unit codes
- Classification of wetlands and wildlife services
- Environmental Protection Agency (EPA) parameter codes
- Codes for taxonomic identification of flora and fauna
- Land use and land cover codes
- Public land survey codes
- Cartographic attribute/feature codes.

9.2.4.4 Data Compression Standards. (U) An area closely related to map and geographic information is data compression because maps require large quantities of data. For example, at a scale of 1:1,000,000, a digitized map of the world requires 30 CD-ROMS. The Army wants maps that are 1:250,000 and 1:50,000. A 1:50,000 scale map of just the land portions of the world would be about 130 times bigger, assuming the same degree of color. There are currently not any known data compression standards, although two, JPEG and DVI are emerging.

(U) The Joint Photographic Experts Group, a joint project of ISO and CCITT, has issued a proposed standard currently referred to as the JPEG standard. The JPEG standard was originally conceived as a companion standard to Group 3 and 4

facsimile standards covering compression of data for gray scale and color. A second proposal is under development by the Moving Picture Experts Group.

(U) A potential de facto standard, called Digital Video Interactive (DVI), uses a proprietary compression scheme, but is backed by Intel Corporation, IBM, and AT&T. IBM and Intel are already marketing DVI products for personal computers.

9.2.5 Standards for Document Interchange Formats

(U) This section summarizes Electronic Data Interchange (EDI) standards, including the EDIFACT standard adopted by ISO. It also addresses standards for office document interchange architectures and formats.

9.2.5.1 Electronic Data Interchange (EDI). (U) EDI provides for a standardized exchange of data between systems by a wide range of means, including exchange of magnetic tapes and the transmission of data by Telex. EDI is a standard for the data, and as such, is outside OSI (OSI standards are for the means of moving that data). EDI is intended to enable data to be interchanged without networking and is used mainly for interorganization communication where internetworking may be undesirable (internetworking is a primary feature of OSI).

(U) Prior to 1985, there were two world-wide EDI standards, UN-TDI/GTDI in Europe and ANSI X12 (*An Introduction to EDI*, July 1987) in North America.[31] At that time, the United Nations tried to produce a single standard for both communities. This standard was the EDI for Administration, Commerce, and Transport (EDIFACT). The syntax for EDIFACT is now an ISO standard (ISO 9735). EDIFACT is based on ISO 646 encoding (7 bits per character--ASN.1 Basic Encoding Rules use the full range of 8 bits in each octet), but it still is not aligned with ANSI X12. A large number of standard messages have been developed based on EDIFACT, and the EDIFACT has been endorsed by many standards bodies and user groups. However, another standard, TRADACOMS, has been developed for use in the UK, based on the UN-GTDI syntax. TRADACOMS is now in wide use in the UK. EDI is cited in UK GOSIP 3.0 in the interim advice on standardization [Ref. 192].

(U) EDIFACT provides data structure and content standards for developing messages for use by importers, exporters, transportation firms, financial institutions, ports, customs, and other business and administrative activities (e.g.,

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31 (U) The number of companies currently using EDI has been estimated at 15,000. Up to 13,000 of these are in the US and about 1,600 in the UK. The number of users is reported to be doubling every

insurance, tourism, construction). EDIFACT was developed by the UN working party on Facilitation of International Trade Procedures to ensure there is only one worldwide standard for EDI. EDIFACT is ISO 9735 and uses the international standard Trade Data Element Directory (ISO 7372).[32] ANSI Committee X12 guides, stimulates, and promotes the development and use of the EDIFACT standards in the United States and Canada. The ANSI X12 Secretariat has noted that differences in syntax control segments, data segments, and data elements continue to exist between EDIFACT and the X12 standard for EDI.[33]

(U) CCITT is preparing a fast-track recommendation in 1990 for an electronic data interchange (EDI) over X.400. This standard will use a new User Agent protocol called PEDI that will include security services necessary to support nonrepudiation. The CCITT EDI user agent will allow CALS formats (e.g., US MIL-STD-1840A, *CALS Originator File Sets and Transfer*) to be supported as body parts.

(U) The US Government Computer Acquisitions and Logistics Support (CALS) initiative is the largest and best known of the EDI proponents. CALS requires full compliance to EDI standards for digital delivery of technical information and interoperability among DoD systems beginning in January 1990. Major applications areas are automation of technical manuals, computer-assisted design, and spares acquisition. CALS standards include EDI for data interchange file management, IGES for engineering drawings, Standard Generalized Markup Language (SGML) for automated publishing, and CGM for technical manual illustrations. The standard currently being used for raster graphics representation is US DoD-unique (MIL-R-28002).

9.2.5.2 Office Document Architecture (ODA). (U) ODA is one of two standards used for describing documents in preparation for electronic interchange, the other is SGML. ODA (ISO 8613) was originally designed for the interchange of office documents between different word processors. The equivalent CCITT Recommendations are the T.410 series (see Appendix D). ODA describes a document in terms of its logical

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year. Source: International Network Services, Limited. Reference: *OSN: The Open Systems Newsletter*, Volume 3 Issue 1 (January 1989).

32 (U) *UN/EDIFACT Information Pack*, SC21 N 3885, 19 September 1989.

33 (U) *X12/DISA Information Manual*, Data Interchange Standards Association, Inc., (DISA--The ANSI X12 secretariat), Spring 1990.

structure or its layout structure or both together. The ODA standard is divided into several parts:

- ISO 8613-1, Part 1: *Introduction and General Principles*
- ISO 8613-2, Part 2: *Document Structures*
- ISO 8613-3, Part 3: *Document Processing Reference Model*
- ISO 8613-4, Part 4: *Document Profile*
- ISO 8613-5, Part 5: *Office Document Interchange Format (ODIF)*
- ISO 8613-6, Part 6: *Character Content Architectures*
- ISO 8613-7, Part 7: *Raster Graphics Content Architectures*
- ISO 8613-8, Part 8: *Geometric Graphics Content Architectures.*

(U) Part 5 of ODA specifies a second method of representation and interchange, using the Office Document Language (ODL) and the SGML Document Interchange Format (SDIF). ODL is an application of the Standard Generalized Markup Language (SGML), and may be used to represent a document structure in accordance with ODA in SGML.

(U) The Profile Alignment Group for ODA (PAGODA) has been formed from the three special interest groups (SIGs) and expert groups (EGs) from the three regional OSI workshops: AOW ODA SIG, EWOS ODA EG, and the NIST ODA SIG. PAGODA is developing ODA profiles based on ISO 8613, *Office Document Architecture (ODA) and Interchange Format.* The Office Document Format (FOD) provides for two types of structure in its proposed taxonomy [Ref. 193]:

- Hierarchically related based on increasing complexity and functionality (simple, enhanced, and extended document structures). The simple document structure is intended to address the general requirements of current word processing applications. The enhanced document structure is intended to address the general requirements of emerging word processing applications that have been enhanced over current applications. The extended document structure would address the general requirements of emerging personal publishing and document processing applications.
- Content architectures for various combinations of character, raster graphics, and geometric graphics content architectures.

9.2.5.3 Standard Generalized Markup Language (SGML). (U) SGML formalizes markup, making it system and processing independent. It is designed for full multi-media database publishing. SGML is a

meta-language, providing the rules for designing and applying a system of markup tags rather than the specific set of tags. The SGML standards are:

- ISO 8879, *Standard Generalized Markup Language (SGML)*
- TR 9573, *SGML Support Facilities--Techniques for Using SGML*
- ISO 9069, *SGML Support Facilities--SGML Document Interchange Format*
- DIS 9070, *SGML Support Facilities--Registration Procedures for Public Text Owner Identifiers*
- DTR 10037, *SGML and Text-Entry Systems--Guidelines for SGML Syntax-Directed Editing Systems.*

(U) SGML has been chosen by the Department of Defense as the documentation standard for its CALS strategy. This strategy is designed to take defence information from its current paper form to a totally electronic mode over the next decade.

9.2.5.4 Distributed Office Applications Model (DOAM). (U) The Distributed Office Application Model (DOAM), DIS 10031, was established to provide a set of common principles to which all DOA standards must adhere. The two parts of this standard, *General Model* and *Referenced Data Transfer*, do not contain any implementable protocols; they are limited to the description of models and tools to be used by DOA standards developers.

(U) An important feature of the DOAM is the client-server model, which allows one part of an application to be implemented in a "client" machine and another part to be implemented in a "server" machine. This possibility of splitting an application allows certain central resources, such as a large database or an expensive laser printer to be shared among a number of users from their work stations.

(U) DOA consists of the DOA model (DOAM) and two specific DOAs: Document Filing and Retrieval (DFR, DIS 10166) and Document Printing Application (DP xxxxx). The DOAM (DIS 10031) addresses the general model, design guidelines for the peer-to-peer (Application Layer) protocol, and Referenced Data Transfer (RDT). Use of ROSE is mandatory in DOAM. The DOAM guidelines are used to define DOA objects (e.g., documents), together with object attributes and criteria for filtering those objects. The DOAM guidelines identify a set of abstract operations such as List, Read, Write, Modify, Copy, Move, Search, Create, Delete, Reserve, Unreserve, Notify, and Abandon. RDT is the mechanism used to perform transfer of objects. RDT was developed to permit "small" systems (e.g., workstations) to handle "large" objects, such as moving an object from a document store to a print service. DFR defines the structure of a document store

and an associated access protocol. DPA defines an access protocol for print services. DOA is being developed by SC18/WG1 [Ref. 194].

9.2.6 Open Distributed Processing (ODP)

(U) ODP falls outside the OSI Reference Model but clearly provides services that could be applicable to ATCCIS. While ODP is discussed in Section 6.2.7, use of ODP may fall within the scope of enhanced interoperability.

9.2.7 Programming Service Standards

(U) This section identifies the types of language, language bindings needed for SQL, software development environments, tool sets, process models, and methodologies, and other programming service standards. It needs be expanded to address specific tools such as compilers, syntax (e.g., ASN.1) analyzers, and other support tools.

9.2.7.1 Ada. (U) Ada is a programming language agreed to be used within NATO and the US DoD[34] as a standard general-purpose high-level programming language. It was introduced in 1979 after the US DoD became concerned about the proliferation of computer languages it was using and determined that none of these languages was suitable for writing DoD software. Ada uses the latest ideas in language design and a standard programming support environment is suggested. In 1983 it was adopted as a standard by ANSI and as a US Military Standard (MIL-STD-1815A). It was adopted as a Federal Information Processing Standard (FIPS 119) on 8 November 1985. In 1987 ISO endorsed it as an ISO standard (ISO 8652).

(U) In 1988, the Ada 9X project was undertaken to revise ANSI/MIL-STD-1815A through a three step process: (1) requirements development, (2) revision of the Ada Language Reference Manual, and (3) implementation demonstrations. In May 1990 the requirements process culminated in the publication of the Ada 9X Project Report: Ada 9X Revision Issues, Release 2 [Ref. 195].

9.2.7.2 Ada Programming Support Environment (APSE). (U) An APSE is an environment for developing software systems written in Ada. At its core is a kernel APSE (KAPSE), which represents general operating system services such as file management services and process and device control services, as well

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34 (U) DoD Directive 3405.1 states that Ada is the preferred computer programming language for all DoD applications except when the use of another higher order language is most cost effective over the application's life cycle. DoD Directive 3405.2 mandates the use of Ada in all computers integral to weapons systems (embedded systems).

as object management services. It is at this level, as opposed to the outer layers, the MAPSE (Minimal APSE) and APSE, that a common set of interfaces is required. The MAPSE consists of software tools that minimally support software development, such as compilers, editors, and linkers, while the APSE provides project-specific tools and services.

9.2.7.3 Common APSE Interface Set (CAIS). (U) CAIS provides a common set of interfaces to the KAPSE. The CAIS standard (US DoD MIL-STD-1838A, 1989) defines a set of interfaces that allows APSE tools to use common operating services and facilities in a standardized fashion. The original plan for the designing of CAIS in the US called for one set of interfaces to be produced at the end of 4 years' work (the original target was 1987). As pressure mounted for an earlier release, the Ada Joint Program Office (AJPO) decided that a limited capability version should be provided before the full CAIS was complete.

(U) The first version of CAIS (US DoD MIL-STD-1838) was published in October 1986. It comprised only those interfaces common to two different APSEs being developed by the US Army and the US Air Force: the Ada Language System (ALS, for the Army) and the Ada Integrated Environment (AIE, for the Air Force). Because of divergent approaches at the KAPSE interface level taken by the ALS and AIE contractors, the KAPSE Interface Team (KIT) and the KAPSE Interface Team from Industry and Academia (KITIA) were formed. Together, the KIT/KITIA produced the first version of the CAIS.

(U) In parallel, the Requirements and Design Criteria Working Group (RACWG), composed of KIT and KITIA members, was established in July 1983 for the purpose of defining a set of requirements and criteria for the design of a second version of the CAIS. In 1985, a contract was awarded to SofTech, Inc., to continue development of this second version of CAIS (CAIS-A). CAIS-A was reviewed publicly in 1987 and was published as a military standard (MIL-STD-1838A) on April 6, 1989 [Ref. 196].

(U) There are no plans, nor is a mechanism currently in place, to update CAIS-A. However, there are plans to merge two standards efforts: CAIS-A and PCTE+ (Portable Common Tool Environment) over the next several years. PCTE is an effort of the European Strategic Programme of Research and Development in Information Technology (ESPRIT); see Section 9.2.7.10. At least two implementations of CAIS-A now exist, one by SofTech for the VAX/VMS environment and one by UNISYS for the SUN/UNIX environment.

9.2.7.4 Pascal. (U) Pascal is a computer programming language originally designed to satisfy two principal aims. The first was to provide a language suitable for teaching programming as a systematic discipline based on certain fundamental concepts clearly and naturally reflected by the language. The second aim was to define a language whose implementations could be reliable and efficient on then-available computers. A Pascal standard was adopted in 1983 as ANSI X3.97 and IEEE 770.

(U) At the same time that the ANSI/IEEE Pascal standard was being developed, the British Standards Institution (BSI) sponsored an ISO draft proposal for Pascal. In 1983, ISO adopted Pascal as a standard (ISO 7185), endorsing British Standard (BS) 6192-1982. While the ISO and ANSI/IEEE Pascal standards are compatible, there are some differences in technical substance as well as some errors in the ISO standard.

(U) In January 1985 the US Federal Government adopted the ANSI/IEEE standard as FIPS 109. The implementation of FIPS Pascal involves three areas of consideration:

- Acquisition of Pascal processors
- Interpretation of FIPS Pascal
- Validation of Pascal processors.

On 10 April 1990, ANSI X3 and the IEEE approved the Extended Programming Language Pascal standard as IEEE 770 and ANSI X3.160.

9.2.7.5 Programming Language C. (U) C originated in the late 1970s as the programming language of the UNIX operating system. It is a general-purpose programming language that features economy of expression, modern flow control and data structures, and a rich set of operators.

(U) C is not a very "high level" language, nor a complex one. Its particular area of application is systems programming (e.g., software for an operating system). Although it was originally implemented on a DEC PDP-11, it is now widely used [Ref. 197].

(U) Its growing popularity, changes in the language over the years, and the creation of compilers by groups not involved in its design, raised the need for a standard in the early 1980s [Ref. 197]. In 1989, ANSI promulgated X3.159, Programming Language C. This standard has not been adopted by ISO or the US Federal Government. However, there is an X3 project (0743-D) to promulgate a standard for Programming Language C++, a higher-level update of C. There is no draft standard as yet, since the first meeting was in March 1990. Estimated completion is 1994. The ISO project designation is JTC1.22.14.

9.2.7.6 COBOL. (U) This programming language, which is primarily used for business applications, is an ANSI (X3.23-1985) standard that was also adopted in 1985 by ISO (ISO 1989). On 18 March 1986, it was adopted by the US as FIPS 21-2. A revision of ANSI X3.23 is currently in the planning stages. Public review began in 1990 with approval expected about 1999. An addendum to ANSI X3.23 for intrinsic functions (ANSI X3.23A-1989) was recently approved, and a Correction Addendum to ISO 1989 (*Programming Language COBOL*) is currently out for public review. The X3J4 Accredited Standards Committee on COBOL has recently received approval to work on an Addendum for Multi-Octet Character Sets that are necessary for Asian languages. It is also working on a COBOL Interface to the Forms Interface Management System (FIMS) (ANS Project 0676-D). Object-oriented extensions to COBOL are also under consideration by the committee.

9.2.7.7 FORTRAN. (U) In 1978, ANSI promulgated a standard for FORTRAN (ANSI X3.9), a programming language for scientific numerical computation that has wide use and many variations. In 1980 this standard was endorsed by ISO (ISO 1539). FIPS 69 adopted X3.9-1978 on 4 September 1980 as a US standard to promote portability of FORTRAN programs for use on a variety of data processing systems. The most recent FIPS (FIPS 69-1) was issued on 24 December 1985; a revised ANSI standard has yet to be issued.

9.2.7.8 LISP. (U) LISP is currently the most popular computer language used in artificial intelligence (AI) programming in the US, although Prolog standardization efforts are underway in the UK. LISP is designed for supporting symbolic manipulation and the interactive, trial-and-error style of programming employed by many AI researchers. It was invented in 1958 and has many dialects. The dialects tend to fall into one of two n. n camps: INTERLISP and MACLISP. In the interest of standardization, Common LISP was developed [Ref. 198]. It is not yet an official standard, but was created at the initiative of many vendors and is increasingly becoming the preferred version. Common LISP compilers exist for several mainframe computers [Ref. 199], minicomputers, and microcomputers. The ANSI Standards Committee X3J13 is working on an ANSI standard for Common LISP. Currently, a full draft is under review by the X3J13 committee, and a public review is expected by the end of 1990. Except for efforts to standardize Schema (IEEE P1178) and the AI programming language Prolog, there are currently no standards for knowledge-based specifications or notations.

9.2.7.9 BASIC. (U) BASIC is distinguished from other programming languages in its concern for the unsophisticated or novice user. While BASIC is a general-purpose programming language, it is designed primarily to be easy to

learn, easy to use, and easy to remember. It is oriented toward, but not restricted to, interactive use. Its constructions are kept simple and special rules are kept to a minimum. The ANSI standard for Minimal BASIC (X3.60) was promulgated by ANSI in 1978 and adopted as FIPS 68 in 1980. It was subsequently adopted by ISO in 1984 (ISO 6373). In 1987, ANSI withdrew X3.60-1978 and superseded it with a standard for Full BASIC (X3.113-1987), which was adopted as FIPS 68-2 on 28 August 1987. This revision reflects major changes, improvements, and additions to the BASIC specification. In December 1989 ANSI issued the standard ANSI X3.113A, *Addendum to Programming Language Full BASIC, Modules, and Individual Character Input.*

9.2.7.10 Portable Common Tool Environment (PCTE). (U) The PCTE project was begun in 1983 by the Commission of the European Communities (CEC) European Strategic Programme for Research in Information Technology (ESPRIT). It is now being considered by ECMA Technical Committee 3.3 and is expected to be submitted to ISO for balloting as an international standard [Ref. 200].

(U) The goal of the PCTE project was to describe and prototype tool interfaces that could be used to define a software development environment. The environment would comprise a set of public tool interfaces (PTIs) as well as a data management system. As defined by the PCTE project, a PTI is a non-proprietary interface existing as a library unit that may be used by a tool to provide access to system services. Tool builders might use the interfaces to either integrate or attach their tool products to an environment. The distinction between integration and attachment reflects the degree to which the environment monitors, controls, and makes use of the information on a given tool. An integrated tool makes full use of the services provided by the environment such as logging an audit trail and data management. An attached tool does not. For example, data is maintained in a repository known only to that tool.

(U) The criteria for development of the PCTE were that it be policy and mechanism independent, support a distributed environment, provide easy tool integration, provide a complete interface definition, and provide multi-language support. To accomplish this, PCTE defines the services needed by the tools. The services provided by PCTE include data management, tool execution and communication, distribution and environment management, and programmer interface for user interface management.

(U) Several environments are currently being developed based on PCTE. A highly secure version of PCTE, PCTE+, is also being developed. PCTE+ is planned to be suitable for civil and defense applications [Ref. 201]. ECMA has a PCTE standard based on PCTE+. Issue 3 of the ECMA standard contains an abstract specification with bindings for C and Ada.

(U) The ESPRIT project "accueil de logiciel futur" aims to provide a knowledge-assisted software process model on top of the PCTE [Ref. 202].

9.2.8 Software Environment

9.2.8.1 Bindings. (U) In addition to programming language standards, several standards provide interfaces or connectivity between programming languages and applications. Such "bindings" as they are called exist or are being proposed for the POSIX (IEEE P1003), GKS (ISO 7942), GKS-3D (ISO 8805), PHIGS (ISO 9592), and CGI (ISO 9636) standards.

(U) POSIX bindings are planned for Ada, C, and FORTRAN. The Project Authorization Request (PAR) for IEEE project P1003.5, *Ada Bindings for POSIX,* was approved in December 1987, but a target date has not been established. The PAR for the FORTRAN binding (P1003.9) was approved in February 1989. A PAR has not yet been approved for the C binding (P1003.X).

(U) ANSI and ISO have approved standards for FORTRAN, Pascal, and Ada bindings for GKS. The C binding is currently in the working draft stage. They are:

- ISO 8651-1, *FORTRAN Binding* (ANSI X3.124.1-1985), October 1988.
- ISO 8651-2, *Pascal Binding* (ANSI X3.124.2-1985), October 1988.
- ISO 8651-3, *Ada Binding* (ANSI X3.124.3-1985), October 1988.
- WD 8651-4, *C Binding* (ANSI X3.124.4-199x).

(U) ISO draft standards have been developed for GKS-3D bindings for FORTRAN, Ada, and C. Pascal and LISP bindings are under development. They are:

- DIS 8806-1, *FORTRAN Binding*
- DIS 8806-3, *Ada Binding*
- DIS 8806-4, *C Binding*
- *Pascal Binding* [SC24 N 190] (ANS Project 0545-I)
- *LISP Binding* (ANS Project X3.122.5-199x, estimated completion 1991).

(U) There are ISO standards for Ada and FORTRAN bindings to PHIGS. The Pascal and C bindings are awaiting balloting. All are draft ANSI standards. They are:

- ISO 9593-1, *FORTRAN Binding* (ASC X3.144.1-199x), October 1988.
- DIS 9593-2, *Pascal Binding* (ASC X3.144.2-199x)

- ISO 9593-3, *Ada Binding* (ASC X3.144.3-199x), March 1990.
- DIS 9593-4, *C Binding* (ASC X3.144.4-199x)

(U) FORTRAN and C bindings to CGI are currently ISO working documents and ANSI projects:

- WD 9636-8, *FORTRAN Binding* (ANS 0560-D)
- WD 9636-11, *C Binding* (ANS 0559-D).

9.2.8.2 Software Engineering Environments. (U) With the exception of CAIS and PCTE, few standards efforts exist in the areas of software engineering environments, tools, or toolsets. Among the limited work being done in this area is an IEEE Computer Society Project (P1209) for a Recommended Practice for Evaluating CASE Tools. The Project Authorization Request (PAR) was approved on 1 June 1989. The IEEE Committee has met four times and has published a draft that is still not stable. Balloting is expected within two years.

(U) The Institution of Electrical Engineers (IEE)/British Computer Society Joint Working Party on Software Engineering Standards has also discussed the possibility of investigating CASE tools, in particular, the way in which their use supports conformance to high quality standards. However, to date, their only planned activity is to comment on IEEE P1209. In discussions related to a proposed UK MOD *Ministry of Defence* standard (DEF-STAN-00-55), *Requirements for the Procurement of Safety Critical Software,* the remark has been made that currently available CASE tools would not meet their requirements, since none of the tools have been or can be subject to the kind of formal methods analysis laid down in the proposal [Ref. 203].

(U) Another issue with respect to tools and toolsets is the ability to interconnect tools from different software developers. Consequently, the IEEE Computer Society approved a PAR for a Standard for Interconnections Among Computing System Engineering Tools (P1175) in February 1988. The core of this standard is the Standard Text Language (STL), which describes concepts such as data, conditions, events, and states, as well as transformation, control-transition, and state-transition operations. The proposed standard supports both textual and graphical forms [Ref. 204]. It is currently in the final stages before IEEE balloting.

(U) Other areas where standards are lacking, probably due to technological immaturity, are knowledge-based systems (KBS), expert system tools, and software repository tools.

(U) The UK General Expert System Methods Initiative (GEMINI) is an example of a project that is addressing needs for knowledge-based standards. In

mid-1988, the CCTA launched this project to lay the foundation for a systematic KBS development methodology. A feasibility study concluded that there is strong support for such a method and that its development is both timely and feasible [Ref. 205].

(U) An important method of integrating KBS is by means of the IRDS (ISO 10027). The first area of standardization for expert systems will likely be bindings between expert systems and programming languages, databases, and user interfaces. Progress towards providing decision support and decision making tools and methods is slow but may be stimulated by the early release of the IBM Repository [Ref. 206].

9.2.8.3 Process Models and Development Methods. (U) A software process model is the ordered sequence of activities that occur during the course of software development. Examples of software development process models include the waterfall method, rapid prototyping, and the spiral model. By contrast, a software development method (methodology) is the way the specific development activities are actually carried out by the developer. An example is the object-oriented approach.

(U) There is currently a single US standard, DoD-STD-2167A, *Defense Software Development Standard*, for the process of software development. It superseded DoD-STD-2167, which was tied to the waterfall method and did not easily allow tailoring to other methods. The IEEE has a project underway (IEEE P1074), *Standard for Software Life Cycle Processes*, which will define the processes which comprise the software life cycle and describe the activities required to develop or maintain software in accordance with existing IEEE standards.

(U) There are currently no standards specifically for the development of expert systems. It is not clear that the development of expert systems must follow a different or unique process model.

(U) Development methods tend to be proprietary and not subject to standardization. However, one IEEE project (P1152), *Standard for Object Oriented Programming Language and Environment*, is developing a standard based on the SmallTalk programming language and environment.

9.2.9 Document and File Transfer Standards

(U) ISO, CCITT, and ECMA have developed several standards for the transfer of files and documents. Harmonization of these standards efforts is one of the main topics for the Technical Study Group (TSG-1) on Interfaces for Applications Portability. The standards and their relationships are discussed in this section.

9.2.9.1 Document Transfer and Manipulation (DTAM). (U) DTAM is being developed by CCITT SG VIII. The DTAM protocols are designed to support interactive as well as store-to-store real-time end-to-end communications. They are also suitable for multi-media applications. Telematic applications are currently defined within the integrated, modular approach based on Office Document Architecture (ODA), DTAM, and Document Architecture Operations (DAO, CCITT SG VIII). The telematic applications are Group 4 Facsimile, mixed mode, processable mode, and videotex internetworking. Each telematic application consists of equipment characteristics, document characteristics (selected from ODA), operational characteristics (optional, selected from DAO), and communications characteristics (selected from DTAM).

(U) DTAM differs from FTAM in that the standards address different environments. FTAM satisfies requirements for the transfer of files between different file systems, including retention of generic filing information. DTAM, on the other hand, provides facilities for the storage, management, and retrieval of documents in an integrated office application environment.

(U) Two types of telematic and office environment applications for DTAM are being developed by CCITT SG VIII and ISO JTC1 SC18: conference type and remote document handling. A service called Remote Open Document Editing (RODE) is being proposed for the telematics environment to provide real-time remote editing for content manipulation through use of ODA/DTAM. RODE is expected to fulfill such user requirements as observing changing documents; maintaining identical documents between partners, even when partners have different presentations; providing speedy manipulations; and potentially supporting participation of more than three partners. Services are being defined to enable RODE to support a desk top conference application using DFR as well as RODE [Ref. 207].

9.2.9.2 Document Filing and Retrieval (DFR). (U) DFR (DIS 10166) is the responsibility of ISO/IEC JTC1 SC18/WG4. DFR is one of the office application standards defined by the DOAM and shares common mechanisms with directory services and MOTIS. These mechanisms include attribute definition and filtering facilities, and use of service elements for remote operations (ROSE) and reliable transfer.

(U) DFR also supports a "version management" mechanism. This mechanism allows a document to be declared as a new version of an existing document. When this is done, a "previous-version" attribute points to the previous version of the document, and the previous version correspondingly receives a "next-version" attribute, thus retaining the complete evolution of a given document. All versions of a document contain a "version-root" attribute indicating the first version of the document.

(U) DFR is defined by two draft standards:

- DIS 10166-1, *DFR* - Part 1: *Abstract Service Definition and Procedures*, 1989 [SC18 N 1264, October 1987]
- DIS 10166-2, *DFR* - Part 2: *Protocol Specification*, 1989 [SC18 N 1265], October 1987].

(U) DFR and DTAM both handle primarily ODA documents. They differ in that DFR is not concerned with the inner content of a document, whereas DTAM is concerned with both the whole document and the inner content of the document. Further, DFR provides for filing and retrieval of (whole) documents, where as this capability is not supported by DTAM.

(U) DFR differs from FTAM in that filing and retrieval of documents is DFR's single specific office application. An important difference between these two standards is the manner in which a document or file is identified. DFR uses a "Unique Permanent Identifier" that remains with the object for its lifetime. FTAM uniquely identifies its objects by its pathname from the root through the directories leading to it. In FTAM if the contents of a file are moved to another directory the pathname will change. Also, there is no analogy in FTAM of DFR's version control mechanism.

(U) A joint meeting between SC21/WG5/FTAM and SC18/WG4/DFR in Stockholm in May 1989 concluded that, due to the different user requirements being met by the two standards, a general-store model could not be progressed [Ref. 208].

9.2.9.3 Referenced Data Transfer (RDT). (U) RDT standards have been under development within ECMA TC32-TG5 and ISO/IEC JTC1 SC18/WG4. The abstract service definition has progressed to DIS status as Part 2 of the DOAM (DIS 10031-2). The RDT protocol duplicates functionality provided by FTAM, specifically the simple, efficient transfer of unstructured data (this is provided by FTAM-3 and the FTAM Transfer Service Class). However, a minimal implementation of FTAM would not provide all the apparent RDT requirements, such as security, single/multiple use of reference, finite life of reference, and use over a single association along with the RTSE.

9.2.10 Job Transfer and Manipulation (JTM)

(U) JTM (ISO 8831 and 8832) was originally designed for remote off-line (batch) processing. It uses a processing model based on movement of entities called "documents" and the exchange of these entities with users. Exchanges are specified in work specifications that include a data structure and an envelope carrying the document. In Basic Class JTM a single document can be sent to a processing element. In Full JTM (ISO 8832/DAM1, Full Class Protocol) multiple documents and multiple processing steps

would be permitted.[35] Capabilities of JTM are being included in standards for FTAM (e.g., RA) and the ASEs (e.g., RPC) [Ref. 209].

(U) The US stated in ISO in March 1990 that there are no US user requirements nor any organization in the US willing to provide resources for JTM standards [Ref. 210]. AFNOR has similarly found little interest in industry for JTM and recommended further work be suspended [Ref. 211]. Nevertheless, the reassessment report for JTM Full Class [SC21 N 4679 Revised] recommended completion of the International Standard texts, given the advanced state of the work. The recommendation was approved by SC21 in June 1990 [Ref. 212].

(U) SC21 also agreed in June 1990 to prepare a formal tutorial/usage guide that includes JTM scenarios and shows how JTM fits with other ASEs [SC21 N 4679].

9.3 Profiles of OSI Standards

(U) The following sections provide examples of the profiles of standards being considered for migration toward open information system environments.

9.3.1 NATO Functional Profiles

(U) A number of profiles have been developed in TSGCEE SG9. These include (see Appendix H) the *Military Message Handling System* (draft STANAG 4257), R.131(M)--*Relay for Connecting PSDNs using X.75*, TC 111(M)--*Permanent Access to a PSDN*, and TA 51(M)--*COTS over CLNS and CSMA/CD LAN*. Profiles identified in the *NTIS Transition Strategy* are described in Tables 2, 3, and 4 of Section 4.3.1 and more fully in Appendix B.

9.3.2 International Standardized Profiles (ISPs)

(U) ISO/IEC JTC1 has set up a Special Group on Functional Standardization (SGFS) to develop standards for International Standardized Profiles (ISPs). An ISP is somewhat more general than the common use of the term "profile" in that a profile is a stack of protocols to be used in combination, whereas an ISP is a document in which one or more profiles are published. The procedures adopted for specifying ISPs are unique because international harmonization is intended to be achieved

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35 (U) ISO 8832/DAM 1, *Extension to Specification of the Full Protocol*, 28 May 1990 [SC21 N 5224]. Merged text of ISO 8832 1989 with revised text of DAM1 is provided in SC21 N 5225 dated 28 May 1990.

before candidate ISPs are submitted to ISO. Proposals for ISPs are expected to be accepted by the regional workshops EWOS, NIST OSI Implementor's Workshop, and the Promoting Conference for OSI (POSI) before becoming proposed draft ISPs (PDISPs). As noted in Section 4.3.3.2, the SGFS has developed a three-part draft ISP for FTAM.

(U) Table 13 shows the overall organization and labels (taxonomy) used to identify and distinguish ISPs. It shows the distinctions created by the choice of connection-oriented (CO) or connectionless (CL) modes (see Section 3.7.3).

Table 13. (U) Overview of Taxonomy for International Standardized Profiles

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A	Application profiles using CO-mode transport service (TS)
B	Application profiles using CL-mode TS
F	Interchange format and representation profiles
T	Transport profiles providing CO-mode TS
	- TA CO-TS over CL network service (CLNS) using Transport Protocol (TP) Class 4 as defined in ISO 8073/DAD2
	- TB CO-TS over CO network service (CONS) with provision of TP Classes 0, 2, and 4
	- TC CO-TS over CONS with provision of TP Classes 0 and 2
	- TD CO-TS over CONS with provision of TP Class 0
	- TE CO-TS over CONS with provision of TP Class 2
U	Transport profiles providing CL-mode transport service (TS)
	- UA CL-TS over CLNS
	- UB CL-TS over CONS
R	Relay profiles between T- or U-profiles

(U) An important element of functional standardization, as well as for the Directory (ISO 9594), is the development of an international standard for taxonomy. TR 10000, *Taxonomy Framework*, contains a classification and identification scheme for candidate profiles. This taxonomy is being adopted by TSGCEE SG9 and will be used in forthcoming editions of the *NTIS Transition Strategy*.

(U) There are four classes of ISPs in the taxonomy of TR 10000: application profiles (*AXX nn* for those requiring the COTS and *BXX nn* for those requiring CLTS); interchange format and presentation profiles (*FXX nn*); transport profiles (*TX nnnn* and *UX nnnn* for CO and CL profiles, respectively); and relay profiles (*RX p,q*).

9.3.2.1 Interchange Format and Presentation Profiles. (U) These profiles are coded by information type (three letters), document structure (first digit),

and architecture (second digit). The information types are (the last two have no two-digit extensions):

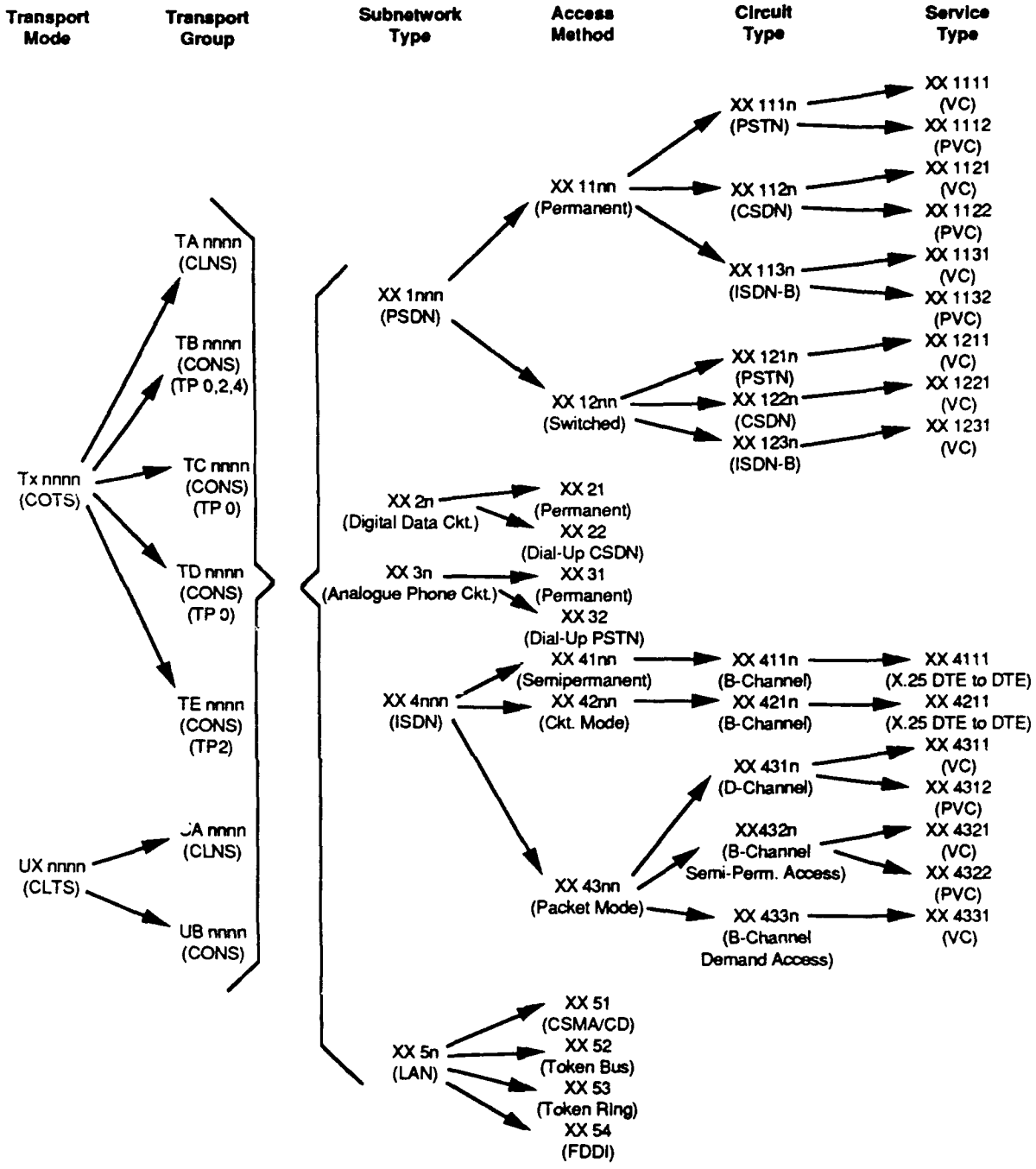
- Office document: *FOD nn*
- Computer graphics: *FCG nn*
- SGML document: *FSG*
- Directory data definitions: *FDI*.

9.3.2.2 Application Profiles. (U) These profiles are coded by application supported and transport mode required (three letters, where the first letter is "A" if requiring COTS and "B" if requiring CLTS--no *BXX nn* profiles have yet been identified), service type (first digit), and functional association (second digit). The applications are :

- FTAM: *AFT nn*
- MHS: *AMH nn*
- VT: *AVT nn*
- TP: *ATP*
- RDA: *ARD*
- OSI Management: *AOM*
- Directory: *ADI n*.

9.3.2.3 Transport Profiles. (U) These profiles (Figure 11) are coded by transport mode (first letter "T" for COTS and "U" for CLTS), transport group (second letter), subnetwork type (first digit), access method (second digit), circuit type (third digit), and service type (fourth digit). The transport groups are CLNS (*TA* or *UA*), TP 0/2/4 over CONS (*TB* or *UB*), TP 0/2 over CONS (*TC*), TP0 over CONS (*TD*), and TP2 over CONS (*TE*). The subnetwork types are PSDN ("1"), digital data circuit ("2"), analogue telephone circuit ("3"), ISDN ("4"), and LAN ("5"). The access methods differ for circuits and LANs:

- Circuit access methods: permanent ("1"), switched ("2"), and packet mode ("3").
- LAN access methods: CSMA/CD ("1"), token bus ("2"), token ring ("3"), and FDDI ("4").



Source: *Functional Profiles for Opens Systems Interconnection,* Joseph R. Onufer, Chairman, TSGCEE SG9 WG1, U. S. Army CECOM ISD, Military OSI Symposium, Symposium Proceedings SP-8, Volume 1, 5-8 June 1990, NATO UNCLASSIFIED.

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Figure 11. (U) Taxonomy for International Standard Transport Profiles

9.3.2.4 Relay Profiles. (U) These profiles are coded by relay type:

- CLNS: *RA p,q*
- CONS: *RB p,q*
- X.25: *RC p,q*
- MAC using transport bridging: *RD p,q*
- MAC using source routing: *RE p,q*
- CLNS to CONS: *RZ p,q*.

The four-digit numbers p and q each use the four-digit numerical classification of the transport profiles. They thereby identify the subnetwork types between which the relay occurs.

9.3.2.5 ISPs. (U) The following ISPs are planned to be developed by the SGFS (Special Group on Functional Standardization, JTC1) [Ref. 213]:

- *AFT 12, FTAM, Positional File Transfer,* Source: EWOS, 1990
- *AFT 22, FTAM, Positional File Access,* Source: EWOS, 1990
- *AFT 3, FTAM, File Management,* Source: EWOS, 1990
- *AMH 11, MHS, Common Transfer Facilities: MTA to MTA (P1),* Source: EWOS, 1991
- *AMH 12, MHS, Common Transfer Facilities: UA to MS (P7),* Source: EWOS, 1991
- *FOD, ODA, "Core 11,"* Source: AOW, 1990
- *FOD, ODA, "Core 26,"* Source: EWOS, 1990
- *FOD, ODA, "Core 36,"* Source: NOIW, 1990
- *TA 52, LAN, Token Bus: CLNS,* Source: NOIW
- *TA 53, LAN, Token Ring: CLNS,* Source: NOIW
- *Tx 41, WAN, ISDN: CS Services,* Source: EWOS [x=B,C,D,(E)], 1991
- *Tx 42, WAN, ISDN: PS Services,* Source: AOW [x=B,C,D,(E)], 1991
- *Tx 1231, WAN, PSDN: Access via ISDN,* Source: EWOS [x=B,C,D, (E)], 1991
- *RD 51.51, Relay, MAC Layer Relay: CSMA/CD to CSMA/CD,* Source: EWOS, 1991
- *RD 51.53, Relay, MAC Layer Relay: CSMA/CD to Token Ring,* Source: EWOS, 1991

- *RA 5x.5y, Relay, Relay at CLNS Level: LAN to LAN*, Source: TBD [x,y=1,2,3]
- *RC 51.111, Relay, Relay at X.25 PLP Level: CSMA/CD to PSDN*, Source: TBD [x,y=1,2,3].

9.3.3 UK and US GOSIP

(U) This section discusses UK GOSIP and US GOSIP. Documentation for UK GOSIP was originally issued in March 1988 for mandatory use in 1990. Figure 12 shows the standards recommended for UK GOSIP. Documents for the current (1990) version of UK GOSIP, *UK Government OSI Profile*, Version 3.1, are [Ref. 214-216]:

- Volume I, *Introduction*
- Volume II, *Specification*
- Volume III, *Procurement Handbook.*

(U) On the facing page, Figure 13 shows the standards and options recommended for US GOSIP [Ref. 93]. These are based on the December 1988 *Stable Implementation Agreements for Open Systems Interconnection Protocols*, Version 2, Edition 1, of the regional NIST OSI Implementor's Workshop [Ref. 31].

(U) Note that only the CL-mode network layer protocols are recommended for packet switched wide area networks (WANs) in US GOSIP, whereas the UK GOSIP recommends a connection-oriented network layer for packet switching. UK GOSIP has been endorsed by representatives from both France and Germany. TSGCEE SG9 recognizes the differences between the recommendations and plans to allow for both implementations to be valid. A technical issue [Ref. 217] may be whether a component may need to be developed with the capability to interconnect a connectionless and a connection-oriented network layer. In June 1990, NIST presented a paper [Ref. 218) to the Military OSI Symposium at the SHAPE Technical Centre. This paper outlined an approach to extending the GOSIPs of both the US and the UK in which the additional standards could be used to achieve interoperability between systems based on those GOSIPs. Neither the US nor the UK has adopted a plan to converge or extend their respective GOSIPs to achieve interoperability.

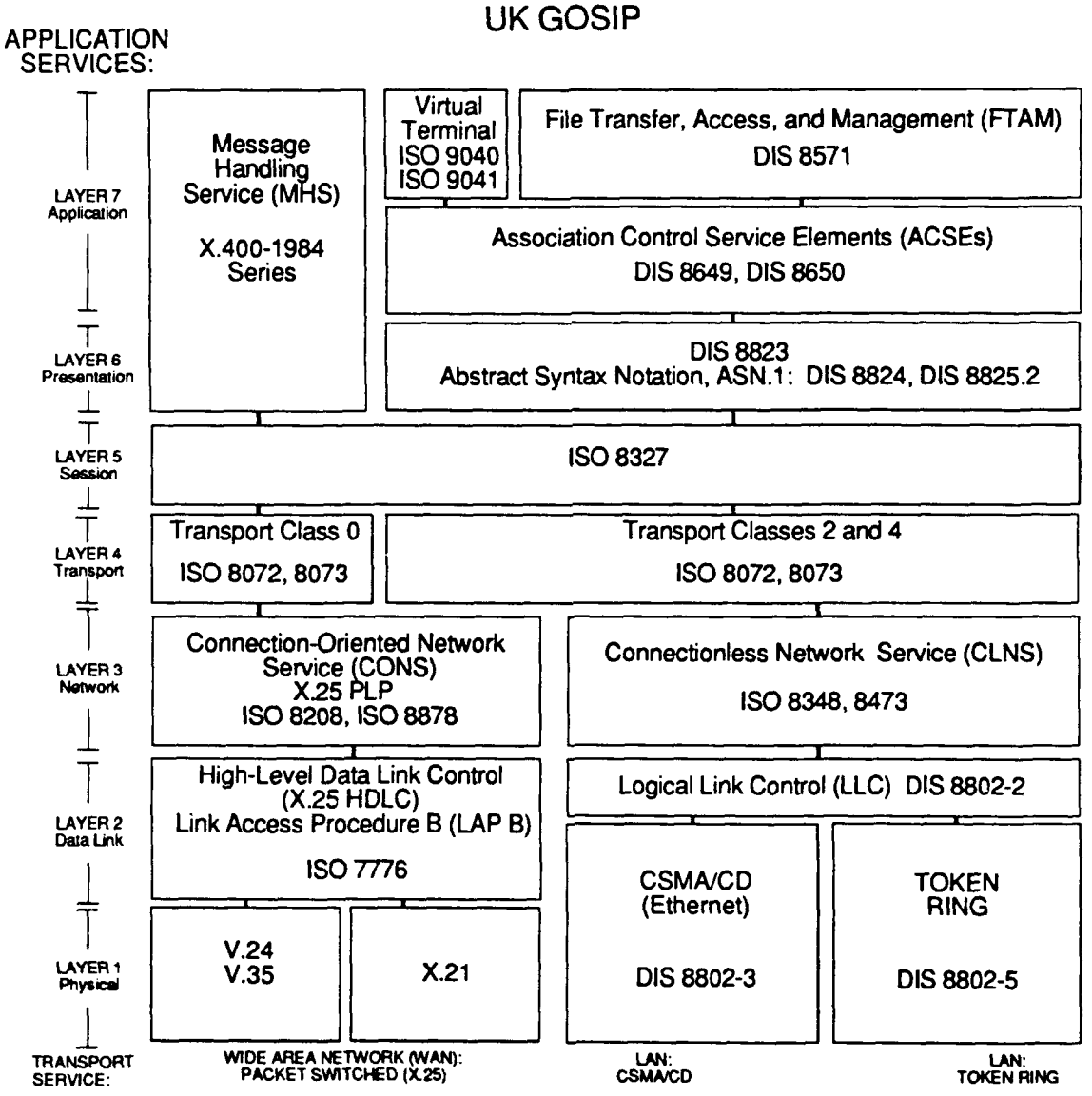

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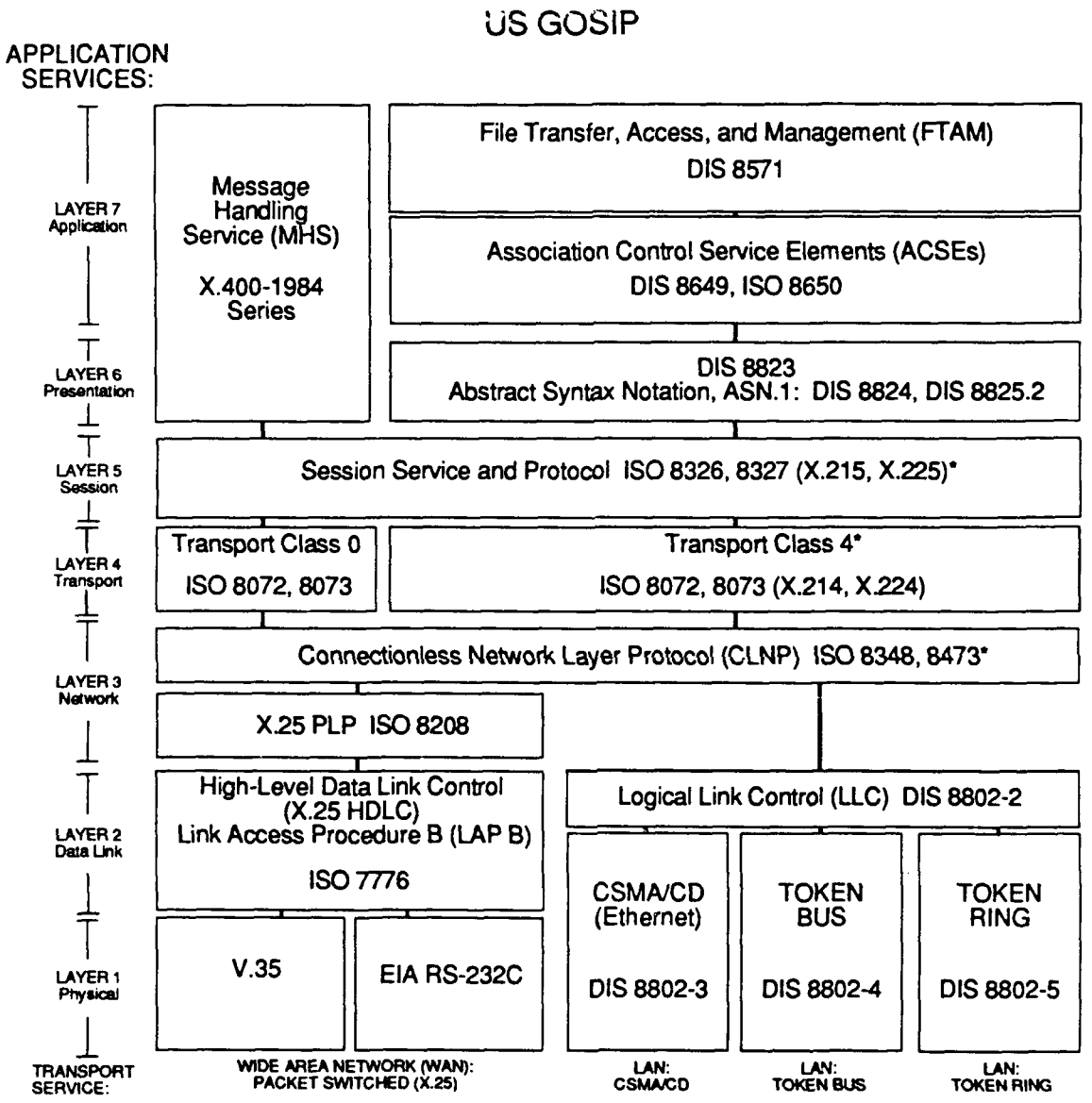
Figure 12. (U) Stacks of Standards Recommended for UK GOSIP



*Required for all conformant systems.

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Figure 13. (U) Stacks of Standards Recommended for US GOSIP

(U) In the next (1991) version of US GOSIP, the following protocols are scheduled to be included: VT (TELNET and Transparent Profiles), end-system to intermediate system (ES-IS) network layer protocols, connection-oriented network service, and ODA/ODIF. These protocols would be added in 1992: directory services (CCITT X.500), interim network management, ISDN, VT (page, scroll, and forms), connectionless transport, 1988 CCITT extensions to MHS, FTAM extensions, and Fiber Distributed Data Interface (FDDI). Future versions of US GOSIP will continue to be based on the agreements reached in the regional NIST Implementor's OSI Workshop. GOSIP 2.0 will be based on *Stable Implementation Agreements for Open Systems Interconnection Protocols*, Version 3, Edition 1 [Ref. 219]. Working agreements in that workshop that have not reached final form are found in the *Working Implementation Agreements for Open Systems Interconnection Protocols: Continuing Agreements*. Reference 220 (February 1990) is the most recent version of the *Continuing Agreements*, based on the Proceedings of December 1989 NIST OSI Implementor's Workshop. These agreements provide the basis for projections of US GOSIP for 1992 and beyond.

(U) A detailed description of the plans, based on US GOSIP, to introduce OSI protocols into the US DoD is provided in *The Department of Defense Open Systems Interconnection (OSI) Implementation Strategy* [Ref. 222]. The baseline for US tactical implementation of OSI standards and protocols will be based on the work of TSGCEE SG9, the *NTIS Transition Strategy*, and associated STANAGs. Tactical networks may use GOSIP-specified lower-level protocols until NTIS protocols are developed and commercially available. When the NATO standards are complete, approved, and available, those required for DoD use will be introduced as GOSIP Advanced (post-1989) Requirements [Ref. 221].

9.3.4 European Procurement Handbook for Open Systems (EPHOS)

(U) Decision 87/95 from the European Community (EC) requires the specification of OSI standards for public procurements. A document is being developed by France, Germany, and the UK to provide guidance for such procurements. The document is called the European Procurement Handbook for Open Systems (EPHOS) and is based on base profiles of the UK GOSIP specification. Where possible, EPHOS will cite European standards and ISPs.

9.3.5 International Versions of GOSIP

(U) Initiatives have been taken to develop an international version of GOSIP. The initial meeting in October 1988 was sponsored by the United Kingdom, with participation from France, Germany, Canada, Japan, Sweden, and the United States. The next meeting in Japan will highlight attempts to gain support from other Pacific nations.

9.3.6 Workshops Promoting OSI

(U) Three regional international workshops have been established to promote OSI. These are the EWOS, POSI--the Asia/Oceania Workshop, and, for North America, the NIST OSI Implementor's Workshop. A Regional Workshop Coordinating Committee has also been established to promote dialog and harmonization among the regional workshops. The goal of the workshops is to define standards profiles that will ensure interoperability of products from different vendors. As indicated in Section 9.3.3, the *Stable Implementation Agreements* [Ref. 31, 219] from the NIST OSI Implementor's Workshop form the basis of US GOSIP. A companion document, *Continuing Agreements* [Ref. 32, 220], provides the basis for enhancements and future revisions to US GOSIP.

9.4 Standards for Applications Portability

(U) This section identifies the major organizations active in achieving increased applications portability. It also discusses the standards recommended as profiles for applications portability. Each of the major recommendations is based on POSIX. The areas addressed are X/Open (Common Applications Environment), NIST (Applications Portability Profile), Open Software Foundation (OSF), and the Technical and Office Protocol (TOP).

9.4.1 Example Model for the Open Systems Environment

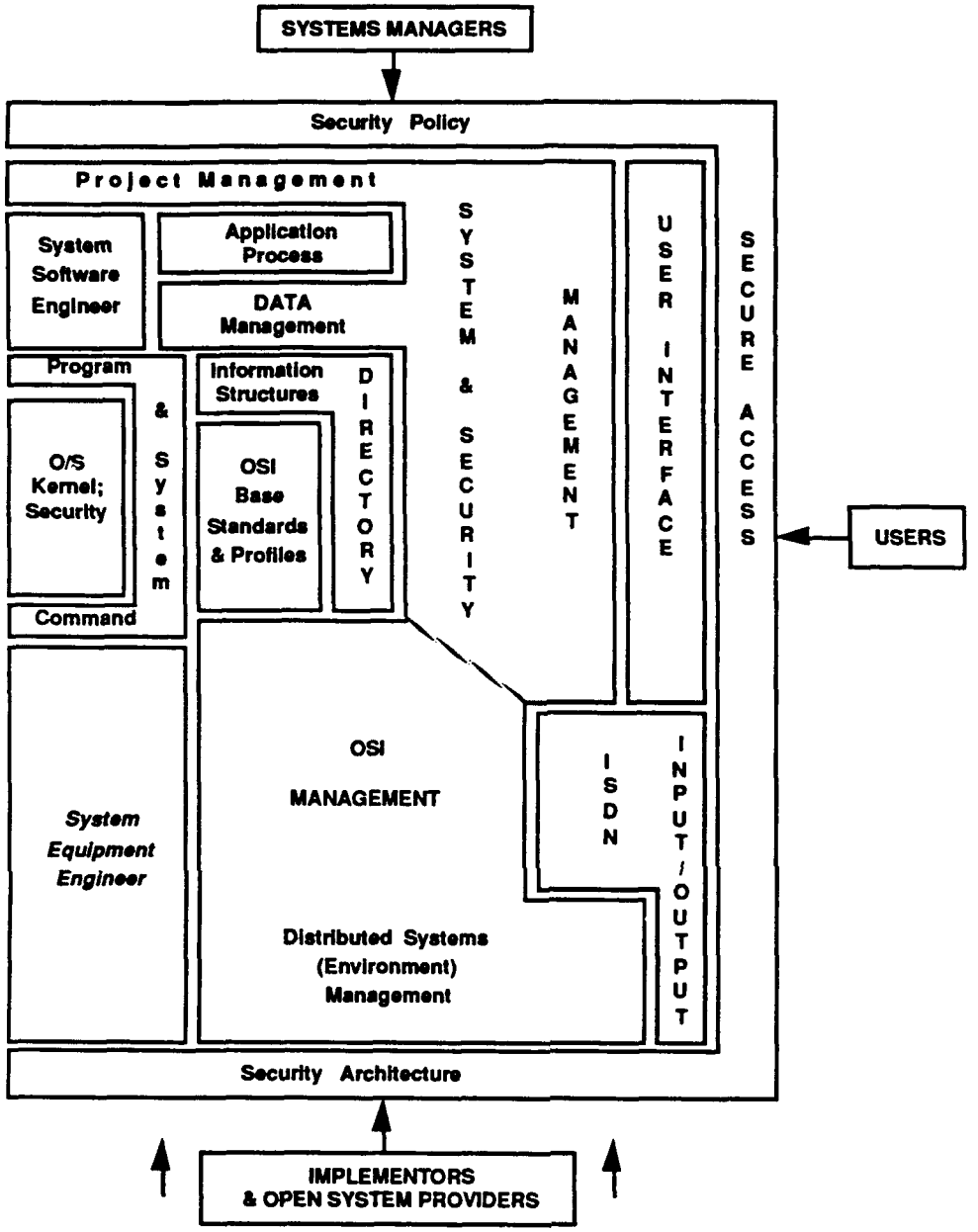
(U) Figure 14 provides an example of a model for the open systems environment developed by the UK MOD [Ref. 222].

9.4.2 Interfaces for Applications Portability (IAP)

(U) JTC1/TSG-1 is conducting a study into the interfaces that need to be standardized in order to facilitate portability of applications. TSG-1 is identifying areas where standards are needed to facilitate application portability and will recommend priorities for the standardization of those interfaces [Ref. 223].

(U) IAPs can be language-independent, operating system independent, or both. Proposed work in SC21 will be for IAPs that are both language and operating system independent. Language-specific constructs could be developed in SC22, as the mapping of abstract data types to language-specific constructs is primarily the work of defining language bindings.

(U) Specification of an API would include definition of data types of the interfaces and may include rules for describing behaviour and sequencing of functions within an interface (e.g., blocking or non-blocking procedure calls) and levels of enforcement of these rules. A model of APIs is needed and should be related to or possibly included in the models for XALS and ODP. It has been proposed that the API model, as well as the XALS and ODP models, should include a means to extend the interface to include user- or application-specific extensions or abstractions. For example, it should be possible to invoke a procedure to store application data type within the X.500 Directory Service without changing the interface definition [Ref. 224].



Source: *Scope for MOD Information Technology (IT) Standardization and Responsibilites,* UK MOD Information Technology Standards Board, 11 August 1989, UNCLASSIFIED.

Figure 14. (U) A Model for the Open Systems Environment

9.4.3 X/Open Common Applications Environment (CAE)

(U) This section discusses the CAE developed by the X/Open international consortium and specified in the X/Open Portability Guide [Ref. 59-61, 225, 226]. The Portability Guide recommends standards and options within standards to achieve an open environment in which new applications can be ported without modification. Several international consortiums have endorsed the X/Open CAE as a basis for developing open environments. The JTC1 has formed a special study group for CAE (and the Applications Portability Profile discussed in the next section) extensions to OSI. Guidance for US GOSIP now recommends [Ref. 227] that the CAE be included in all OSI transition strategy plans being developed by the Services and Agencies.

(U) The foundations of the X/Open CAE are the interfaces of the UNIX System V operating system, as defined in the AT&T System V Interface Definition (SVID), and the C language. The X/Open CAE consists of features grouped in five functional areas: operating system, languages, data management, hardware, and networking. The Third Edition of the Portability Guide (XPG3), published in 1989, defined the CAE in seven volumes:

(1) System V specification commands and utilities

(2) System V specification interface and headers

(3) System V specification supplementary definitions

(4) Programming languages (revised from earlier version; the COBOL definition is aligned with ANSI COBOL 85)

(5) Data management (revised)

(6) Window management (completely new)

(7) Networking surfaces (completely new).

The next phase of the X/Open CAE will complete the convergence with the current POSIX standard (IEEE P 1003.1).

(U) The primary feature of the operating system is the X/Open System V Specification (XVS) that defines the applications interfaces to be provided by the underlying operating system. Another feature of the operating system functional area is the X/Open Native Language System, which is a set of interfaces designed to facilitate the

development of applications that can operate in different languages and cultural environments. These two features are defined in the following ways:

- XVS mandates the entire SVID base definition with the exception of the mathematics group.
- XVS has extended the SVID, including extended use of symbolic names to replace numeric constants.
- Some of the SVID kernel extensions are optional in XVS (use of these options could restrict portability).
- The Native Language System is supported by a message catalogue system (messages in the appropriate language are retrieved at run time); a mechanism whereby native language, local custom, and code-set requirements can be identified to applications at run time; enhanced interface definitions of standard C library functions to provide language-dependent character-type classification and special conversions; and a set of standard commands and library functions that will operate correctly with 8-bit characters.

(U) The C language is the primary feature of the language functional area. The X/Open Portability Guide provides guidelines for writing program designed to be portable and to avoid problems that arise between the AT&T System V C language standard (used for the initial X/Open standards) and the draft standard issued by ANSI X3J11. X/Open has also established definitions for COBOL (based on ANSI X3.23-1974), FORTRAN (based on FORTRAN 77, ANSI X3.9-1978), and Pascal (based on ISO 7185-1983 Level 1).

(U) Data management includes Indexed Sequential Access Method (ISAM) interfaces that are defined for creating, managing, and manipulating indexed files, and SQL for access to relational database management systems. The ISAM definition is based on Version 2.10 of C-ISAM by the Informix Corporation. SQL is based on ISO 9075 (ANSI X3.135-1986) but contains extensions and deviations (see Section 6.2.2.2).

(U) Hardware includes media and formats defined for transferring source code in machine-readable form. The features include 40- and 80-track 5 1/4-inch floppy disks, 1/2-inch magnetic tape, and utilities for transferring files. The primary magnetic tape format is 9-track, phase-encoded at 1,600 bits per inch.

(U) Networking is based on ISO standards and interim standards recommended by the Standards Promotion and Applications Group (SPAG). X/OPEN is working to develop definitions in three areas where there are not yet standards:

- Generalized inter-process communications, with detailed definitions for message passing between processes, shared memory, and semaphores
- Distributed file system
- Distributed transaction processing.

(U) XPG3 was offered to CEN/CENELEC as a standard in 1989. Balloting on prENV 40002 was unsuccessful [Ref. 228]. XPG3 consists of 12 components (listed with reference to other standards work as applicable):

(1) X/Open System Interfaces (XSI) Commands and Utilities (DP 9945-2, IEEE P1003.2)

(2) XSI System Interfaces and Headers (ISO 9945-1; IEEE P1003.1)

(3) XSI Internationalization

(4) XSI Curses Interface

(5) Source Code Transfer

(6) C Language (DP 9899; ANSI X3.159; SC22/WG14 work)

(7) COBOL (ISO 1989; SC22/WG4 work)

(8) Index Sequential Access Method (ISAM) (ANSI X3.23 work)

(9) SQL (ISO 9075)

(10) Window Management Library Interface

(11) Transport Interface (IEEE P1103.8)

(12) Personal Computer Interworking.

(U) The following summarizes some of the comments provided to CEN and EWOS regarding the adoption of the Portability Guide as an ENV [Ref. 228]:

- XPG3 depends totally on UNIX, which needs an AT&T license, and the AT&T version of Programming Language C, which differs from ongoing work in SC22/WG14 (Denmark).
- The X/Open COBOL does not agree with ISO 1989 COBOL; the X/Open recommendations appear to match only one existing product (the MicroFocus compiler). X/Open COBOL excludes some features and specifies some extensions to ISO 1989. There is no real coordination between X/Open recommendations and SC22/WG4 (France).
- The X-Windows standard differs from the one developed at MIT and currently being used to progress such work in ANSI for possible submission to JTC1 (UK).

9.4.4 NIST Applications Portability Profile

(U) This section discusses the Applications Portability Profile developed by the NIST. The NIST approach to applications portability is based on recognition of the need for an architectural approach that provides interfaces for functionality to accommodate a broad range of applications requirements. The functional components of the architecture are viewed as a "tool box" of standard elements that can be used to develop and maintain portable applications. These tools are based on an open systems concept and are required to be developed as an integrated collection of nonproprietary standards.

9.4.4.1 Architectural Approach. (U) Figure 15 provides a high-level view of the architectural approach that underlies the Applications Portability Profile. The shaded area in Figure 15 identifies the primary elements of the profile: an operating system interface (POSIX), database management, data interchange, network services, user interface, and programming services. The network services contain elements to support an open systems interconnection for data communications and to support file management. Database management services include both database languages and support for developing and maintaining data dictionaries. Programming services include programming languages. POSIX is shown as the operating system interface that enables the other elements of the profile to be essentially isolated from a specific operating system and specific hardware. The user interface provides support for windowing and menus, and the data interchange functions support business graphics, engineering graphics, and document processing. Applications make use of standard, nonproprietary interfaces to the functions provided by the profile. Figure 15 does not represent all possible interfaces among the elements of the profile, nor does it show all the ways a user can access these elements. For example, a user would normally execute applications via the user interface or the data interchange functions, but clearly some applications require no special interface. Further, users can be expected to need direct access to the data management service.

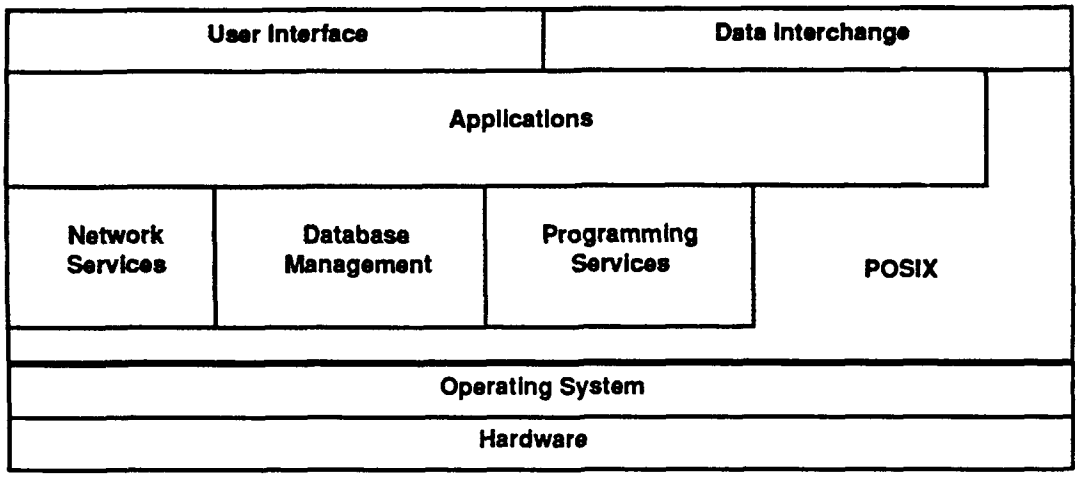


Figure 15. (U) An Example View of the Architecture for the Applications Portability Profile

(U) Table 14 identifies the elements (tools) and the associated interface specifications of the recommended standards for the Applications Portability Profile. The key elements are: OSI for data communications; (extended) POSIX for the operating system interface; SQL and IRDS for database management; and X-Windows for the user interface.

(U) An extended version of POSIX is recommended for the operating system interface (see Section 5.2.1). SQL Standard Database Language (see Section 6.2.2.2) and the IRDS data dictionary standard [Ref. 229] (see Section 6.2.4) are recommended for database management. Recommended for data interchange are:

- GKS and CGM (see Section 9.2.3)
- Initial Graphics Exchange Specification (IGES), used for engineering graphics
- Product Data Exchange Specification (PDES)
- SGML (see Section 9.2.5.3)
- ODA/ODIF (see Section 9.2.5.2).

Table 14. (U) Standards for the Applications Portability Profile

UNCLASSIFIED

Function	Element	Reference for Standards
Operating System	Extended POSIX	IEEE P 1003.1+Extensions (FIPS 151)
Database Mgmt	SQL	IS 9075 (FIPS 127)
	IRDS	ANSI X3.138 (proposed FIPS)
Data Interchange		
Business Graphics	GKS	ISO 7942, ISO 8651, ISO 8805
	CGM	ISO 8632
Engineering Graphics	IGES, PDES	NBSIR 86-3359, NBSIR 88-3813
Document Processing	SGML	ISO 8879, ISO 9069, ISO 9070, TR 9573
	ODA/ODIF	ISO 8613
Network Services		
Data Communications	OSI	GOSIP (FIPS 146)
File Management	NFS	IEEE P1003.8/x
User Interface	X-Windows	ANSI X3H3.6 (Version 11, Release 3)
Programming Services	C	ANSI X3J11/86-151-Oct 1986, X3.159
	COBOL	ANSI X3.23-1974,85, FIPS 021-2
	FORTRAN	ANSI X3.9-1978, FIPS 069-1
	Ada	FIPS 119
	Pascal	ISO 7185-1983 (FIPS 109)

(U) Standards and options identified in US GOSIP (see Section 9.3.3) are recommended for the open systems data communications, and Network File Service (NFS) is recommended for file management. X-Windows is recommended for the user interface, providing a non-proprietary windowing capability. Five standard programming languages are recommended (C, COBOL, FORTRAN, Ada, and Pascal), but standard bindings to POSIX for these languages are still being defined [Ref. 58,62, 230].

9.4.4.2 NIST Approach to IAPs. (U) The IEEE Computer Society's Technical Committee on Operating Systems (TCOS) has formed a number of working groups to progress POSIX and other standards that are required to facilitate applications portability. Table 15 identifies the documents (and working groups known by the same name) being prepared by IEEE on areas other than POSIX for application portability [Ref. 57]. The scope and status of POSIX standards work is discussed in Section 5.2.1.

Table 15. (U) Applications Portability Standards Being Developed by IEEE for Submission to ISO Through ANSI

UNCLASSIFIED

P1003.0, *Applications Portability Guide*--addresses the broad applications portability issues, such as: benefits and risks of open system architecture, architectural framework for portability, applications portability concepts, operating systems services, data management and interchange services, data interchange services, graphics services, network services, user interface services, and languages/application development environment services
P1201.1, *Interfaces for User Portability*--defines a formal standard for programming interfaces for the portability of application software that employs Graphical User Interfaces (GUIs) based on the Xt Intrinsics and Xlib programming interfaces defined by the X-Window System
P1201.2, *Drivabiiity*--defines a recommended practice for those elements and characteristics of user interfaces that must be consistent to permit users to easily transfer from one look-and-feel or application to another
P1201.3, *User Interface Management System (UIMS)*--defines a language-independent dialogue applications programming interface to develop applications systems that are independent of user interface concerns and can be more easily ported across a wide range of user interface styles and technologies; would address such features as: separation of presentation-dependent and presentation-independent aspects, and mechanisms for data and control exchange between application and dialogue layers (not yet approved by TCOS)
P1201.4, *Xlib*--submits for direct ballot, without any changes to semantics or syntax, the MIT X Consortium's X-Window System specification X11 (Release 4) of the Xlib functional specifications with integrated C language binding (direct ballot planned for early 1991)
P1224, *X.400 Mail Services Applications Programming Interface (API)*--defines an API to X.400 mail services for gateways ... supports transfer of mail through an X.400 message transfer system (status is uncertain due to lack of support)
P1237, *Remote Call Procedure (RPC) Interface Language*--defines an interface description language and a very limited set of procedure interfaces to allow applications to use an underlying RPC mechanism layered on an OSI stack (balloting planned for mid-1992 and approval early in 1993)
P1238.1, *OSI Application Program Interfaces*, Part 1: *Common Connection Management and Supporting Functions*--defines an API model for connection-oriented OSI Application Layer services (ballot in early 1992 with P1238.2)
P1238.1, *OSI Application Program Interfaces*, Part 2: *File Transfer, Access, and Management (FTAM)*--provides an application program interface to the detailed OSI FTAM services and higher-level user-oriented FTAM-based services (ballot in early 1992 with P1238.1)

Source: *Briefing on POSIX*, NIST, 12 June 1990, UNCLASSIFIED.

(U) A review of the interface specifications for the Applications Portability Profile shows that there are not yet international standards for many of the elements of the recommended architecture. Some are being considered by ANSI, IEEE, and other standards defining bodies, and others are US standards. For example, X-Windows, originally developed by the "X" Consortium at the Massachusetts Institute of Technology, is being considered by the X3H3.6 ANSI working group, and the C language bindings are being considered by the X3J11 ANSI working group. NIST is developing interim standards for file management and is recommending NFS to IEEE P1003 as the best starting point for these interfaces [Ref. 62].

9.4.5 Open Software Foundation (OSF) Profiles

(U) The OSF has identified a Level 0 portability profile that is based on the following elements:

- POSIX and the Third Edition of the X/OPEN Portability Guide
- Programming language bindings for ANSI C, COBOL, Pascal, Ada, BASIC, and LISP
- X/Windows
- GKS and PHIGS for graphics
- OSI protocols for networking
- Database Language SQL.

(U) The Level 1 OSF profile standards are still being defined through a request for technology (RFT) process. The base standard for the operating system will be the IBM AIX Version 3 of UNIX. This will be compatible to UNIX System V Releases 2.0 and 3.0 and conformant to POSIX [Ref. 231]. The graphical user interface will be a combination of the Microsoft OS2 Presentation Manager, the Hewlett-Packard window manager, and the DEC toolkit.

(U) OSF is planning a develop a Distributed Computing Environment that includes such "technologies" as Architectures, RPC, Naming and Directory, Authentication and Authorization services, Time Management services, Distributed File services, and others [Ref. 232].

9.4.6 Technical and Office Protocol (TOP)

(U) The TOP is part of a combined industrial and government effort on the part of users to specify a profile of standard protocols that can be used in commercial applications to provide connectivity and interoperability. TOP is associated with another effort, Manufacturing Automation Profile (MAP).

(U) The TOP specification [Ref. 233] defines a functional network for distributed information processing for technical and business functions. TOP Version 1.0 (November 1985) is summarized in Table 16. It provides for Carrier Sense Multiple Access/Collision Detection (CSMA/CD) and Token Bus LANs using the connectionless X.25 Internet Protocol and the Class 4 transport protocol. FTAM is supported at Layer 7.

(U) TOP Version 3.0 was released in 1989, and it is expected to have a 6-year stability period before release of another version. It provides not only FTAM but also VT, Directory services, network management, and MHS at Layer 7. It further includes the ODIF (ISO 8613), Computer Graphics Metafile Interchange Format

(DIS 8632), Product Definition Interchange Format (PDIF), and the GKS interface (ISO 7492). IGES Version 3.0 from ANSI [ANSI DP ANS Y14.26M-1986, Ref. 234] is included. At the lower layers, TOP Version 3.0 provides for Token Ring LANs and for X.25 packet switching via X.21 and X.21 bis at Layer 1. TOP Version 3.0 is summarized in Table 17.

Table 16. (U) Standards for TOP Version 1.0

UNCLASSIFIED

Layer	References for Standards
7. Application	ISO 8571 (FTAM)
6. Presentation (Null Layer)	(ASCII and binary encoding)
5. Session	ISO 8327
4. Transport	ISO 8073 (Transport Class 4)
3. Network	ISO 8473 (Connectionless and for X.25--Subnetwork Dependent Convergence Protocol, SNDCP)
2. Data Link	ISO 8802/2 (Type 1, Class 1 Logical Link Control)
1. Physical	ISO 8802.3 (CSMA/CD Media Access Control) ISO 8802.4 (Token Bus Media Access Control)

(U) The international organization, Open Systems Interconnection for Technical and Office Protocol (OSITOP), has been examining architectural issues and has produced a position paper on a solution for connection-oriented network service (CONS) and connectionless-oriented network service (CLNS) internetworking. This paper concludes that:

- It is not realistic to sidestep this issue by expecting that one of the two incompatible sets of protocols (CONS or CLNS) be abandoned or by accepting the existence of two non-communicating OSI islands.
- Three solutions are valid, although not architecturally correct according to OSI principles:
  - The "265" internetworking function (based on TP4 over CONS)
  - A Distributed System Gateway (DSG)
  - A Multi-System Distributed System Gateway (MSDSG).
- OSITOP recommends the MSDSG solution.

SC21/WG6 is reportedly preparing a technical report that is based on the definition of an MSDSG [Ref. 235].

Table 17. (U) Standards for TOP Version 3.0

UNCLASSIFIED

Layer	References for Standards
7. Application	ISO 8571 (FTAM) CCITT X.400-1984 (MHS) ISO 9041 (VT, subset VT-B) ISO 8613 (ODIF) ISO 8632 (CGM) ISO 7492 (GKS) ISO 9594 (Directory) ISO 9595 and 9596 (Network Management) ISO 8649 and 8650 (ACSE)
6. Presentation	ISO 8823
5. Session	ISO 8327
4. Transport	ISO 8073 (Transport Class 4)
3. Network	ISO 8473 (CLNP, SNDCP) CCITT X.25 PLP
2. Data Link	ISO 8802/2 (Type 1, Class 1 Logical Link Control) CCITT X.25 HDLC (LAPB)
1. Physical	ISO 8802.3 (CSMA/CD) ISO 8802.4 (Token Bus) ISO 8802.5 (Token Ring) CCITT X.21 and X.21 bis (Packet Switching)

9.5 Other Profiles and Transition Strategies

(U) This section is intended to be expanded to address additional activities and options to support transition from existing military and other standards to standards for open environments. Examples are application gateways, test systems, and test methodologies. Efforts to highlight functional standards, select stacks of mature standards and options within standards, and harmonize implementations would be examined. One example is the *Guide to the Use of Standards* [Ref. 236] developed by SPAG in Europe. Functional standards based on OSI standards are being developed by the Interoperability Technology Association for Information Processing, Japan (INTAP), specifically towards an interoperable distributed database system [Ref. 237]. Recommendations for functional standards and cooperation with European and US organizations and companies are also provided in Japan by POSI.

(U) Initial profiles for Cooperation for Open Systems Interconnection in Europe (COSINE) have been released. These profiles are summarized in Table 18. In addition to those standards cited in the table, COSINE is evaluating:

- Virtual Terminal, ISO 9041 (with AD2 screen mode)
- EWOS Profile A/122 for file access
- Additional message handling services (CCITT X.400-1988)
- Job Transfer and Manipulation (JTM), ISO 8832 and ISO 8833.

Table 18. (U) Standards for COSINE Profiles

UNCLASSIFIED

Layer	References for Standards
7. Application	ENV 41204 (FTAM) ENV 41910 (Remote Terminal Access) EWOS Profile A/111 (File Access) RARE MHS and CCITT X.400-1884 MHS Services Remote Job Entry (to be defined in EWOS)
6. Presentation	(Null Layer)
5. Session	(Null Layer)
4. Transport	(Connection-Oriented)
3. Network	(Connection-Oriented)
2. Data Link	CCITT X.25-1984
1. Physical	Local Area Networks (not specified)

10. STATUS OF NATO OSI DATA COMMUNICATIONS STANDARDS

10.1 Introduction

(U) This chapter and the next examine NATO efforts to specify and implement open system standards and architectures to achieve interoperability. The purpose is to (1) assess the progress being made in NATO to incorporate military requirements in international standards and to define, where necessary, extensions to those standards, and (2) identify the NATO standards and profiles that may be applicable to ATCCIS.

(U) This section is followed by a discussion of the eight military requirements defined by TSGCEE SG9 (Section 10.2) and an overview of SG9's organization and the plans and activities of the working groups (WGs) within SG9 (Section 10.3). Section 10.4 provides an assessment of the status of draft OSI STANAGs, with particular attention to the way in which each draft STANAG addresses the military features. The chapter concludes with a summary of related standards work in NATO bodies (Section 10.5) and the findings (Section 10.6).

10.2 Military Requirements for NATO OSI

(U) This section summarizes the requirements associated with incorporating military enhancements into open systems interconnection (OSI) standards. Within NATO, this work has been assigned to TSGCEE SG9. General information on NATO and international standards bodies concerned with OSI standards is provided in Appendix F.

(U) Beginning in February 1983, a number of military requirements have been identified in NATO that are not adequately covered by existing OSI standards. Eight military features were identified in the NATO Interoperability Management Plan (NIMP) [Ref. 101], and TSGCEE SG9 has recommended that the OSI Reference Model (STANAG 4250) be extended to provide support for these features:

- Multihomed, mobile host systems
- Multi-endpoint connection
- Internetworking
- Network/system management functions
- Security
- Robustness and quality of service
- Precedence and preemption
- Real-time and tactical communications.

(U) Table 19 gives the description of the eight military features as provided in *Use of OSI Standards in NATO--Strategic and Technical Issues*, March 1988 [Ref. 238].

Table 19. (U) Eight Military Features for Enhancing OSI in NATO

UNCLASSIFIED

(1)	Multihomed and mobile host systems. Multihoming is a mechanism for attaching an end system to two or more network access points without the need for a system setting up a call to it to be aware of the extra connectivity. In addition to enhancing survivability, this facility may be extended to support "mobile hosts" such as aircraft and ships.
(2)	Multi-endpoint connections [multi-addressing; multipeer data transmission (MPDT)].[36] In order to transmit data to a number of recipients, it is usually necessary to establish several connections and send separate copies of the data across each connection in turn. More efficient use is made of the communications resources if the sender has to transmit only one copy of the data. The network then takes care of routing, control, and distribution of the data.
(3)	Internetworking. Mechanisms are required to facilitate the interconnection of various NATO systems at the boundary point between subnetworks.
(4)	Network or system management functions. Management functions are required that may be of greater sophistication than those considered satisfactory for civilian networks. Management of broken networks in which layers of protocols are inoperable and fast responses to changes in network topology are essential to maintain important connections.
(5)	Security. Protection measures are required to prevent unauthorized access to information, preserve the integrity of data, and to mitigate against denial of service. [Note: Security includes access control, authentication, integrity, and confidentiality.]
(6)	Robustness (resilience) and quality of service. The range of quality of service parameters required for military systems exceeds that currently permitted within commercial OSI networks. In particular, in order to maximize the survivability of a network, the NATO aim is to maintain an adequate quality of service to the users (or at least to users operating above a given priority level) in the face of a severely damaged or partitioned network.
(7)	Precedence and preemption. In order to minimize congestion, particularly in a damaged network where resources are at a premium, it is desirable to be able to allocate resources on the basis of priority levels assigned to the connections being routed through the congested area. A facility is therefore required to associate a priority level with a connection when it is established.
(8)	Real-time and tactical communications. Certain applications are prepared to sacrifice such aspects of quality of service as sequencing and guaranteed delivery to achieve the minimum possible transit delay.

Source: *Use of OSI Standards in NATO--Strategic and Technical Issues*, Issue 2, TSGCEE SG9, March 1988, NATO RESTRICTED.

(U) A top-level view of how the eight military features identified above could potentially affect the layers of the OSI Reference Model is provided in Table 20. The entries in the table are based on the most recent editions of the draft OSI STANAGs (see Section 10.4).

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36 (U) As indicated in Section 4.2.1, work in ISO on MPDT has been suspended in SC21/WG1. The completed work is planned to be released as a Technical Report. Canada is serving as the point of contact within SG/9 for maintaining interest in MPDT in ISO. Canada has introduced a draft proposal in ISO on Multi-Party Communications that would address MPDT.

Table 20. (U) Impact of Military Features on Layers of OSI Reference Model

UNCLASSIFIED

Military Feature	OSI Layer						
	1	2	3	4	5	6	7
1. Multihomed, Mobile Host Systems			TBD				X
2. Multi-Endpoint Connection			X			TBD	X
3. Internetworking			TBD				
4. Network/System Management Functions	TBD	TBD	TBD	TBD			X
5. Security	X		X			TBD	X
6. Robustness and Quality of Service	TBD		X	TBD		TBD	TBD
7. Precedence and Preemption			X	TBD			X
8. Real-Time and Tactical Communications			TBD	TBD		TBD	TBD

Key: X = A deficiency has been identified in the applicable draft STANAG.

Sources: *Use of OSI Standards in NATO-Strategic and Technical Issues,* Annex 6, *Summary of Impact of Military Feature on Layers of Reference Model,* TSGCEE SG9, 1 March 1988, NATO UNCLASSIFIED; *Commentaries on the STANAGs of WG1,* Contribution by France to TSGCEE SG9/WG1, February 1989, NATO UNCLASSIFIED; the *NATO OSI Security Architecture (NOSA),* March 1988, NATO UNCLASSIFIED; and recently released draft OSI STANAGs (through July 1990).

(U) TSGCEE SG9 is currently evaluating a proposed revised specification [Ref. 239] of eight military features, in which Robustness and Quality of Service is replaced by Quality of Service and Real-Time and Tactical Communications is replaced by Real-Time Communications. Table 21 provides the new definitions of these features, showing in italics the changes in wording from the current definitions (in effect since 1984).

Table 21. (U) Proposed Revised Military Features

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(1)	Multihomed and mobile host systems. Multihoming is a mechanism for attaching an end system to two or more network access points without the need for a system setting up a call to it to be aware of the extra connectivity. In addition to enhancing survivability, this facility may be extended to support "mobile hosts" such as aircraft, ships, *and land vehicles during the move from one node to another.*
(2)	Multi-endpoint connections [multi-addressing]. In order to transmit data to a number of recipients (a common occurrence in signal handling), it is usually necessary to establish several connections and send separate copies of the data across each connection in turn. More efficient use is made of the communications resources (in particular improved performance in terms of minimizing delay and conservation of bandwidth) if the sender has to transmit only one copy of the data. The network then takes care of routing, control, and distribution of the data. *Some networks behave this way (e.g., IEEE 802.3, net radio, and broadcast satellites).*
(3)	Internetworking. Mechanisms are required to facilitate the interconnection of various NATO systems at the boundary point between subnetworks.
(4)	Network/system management. Management functions are required that may be of greater sophistication than those considered satisfactory for civilian networks. *Examples are:* management of broken networks in which layers of protocols are inoperable; fast responses to changes in network topology essential to maintain important connections; *and counterattack management, to recognize and counter the effects of intelligent attack on and physical damage to the network.*
(5)	Security. Protection measures are required to prevent unauthorized *access to the system, the confidentiality of the information it carries, and to* preserve integrity of data and to mitigate against denial of service.
(6)	Quality of service. The range of quality of service parameters required for military systems exceeds those currently permitted within *civilian* OSI networks. In particular, in order to maximize the survivability of a network, the NATO aim is to maintain an adequate quality of service to the users (or at least to users operating above a given priority level) in the face of a severely damaged or partitioned network. *There is a perceived requirement for an ultimate delivery capability, whereby important communications are sustained, even at very low data rates.*
(7)	Precedence and preemption. In order to minimize congestion, particularly in a damaged network where resources are at a premium, it is desirable to be able to allocate resources on the basis of priority levels assigned to the *messages* being routed through the congested area. A facility is therefore required to associate a priority level with a *message. This requirement is needed for both connection-oriented and connectionless communications.*
(8)	Real-time and tactical communications. Certain applications *(often tactical in nature) require communications with specified time outs, which can be in the range of milliseconds to seconds, and accurate sequencing is essential. Real time may also include high demands on sequencing accuracy.*

Note: Text shown in italics was added to the previous version shown in Table 19 (March 1988).

Source: *Use of OSI Standards in NATO--Strategic and Technical Issues,* Draft for Issue 3, Contribution by the UK to TSGCEE SG9, 4 May 1990, NATO UNCLASSIFIED.

10.3 Organizational Responsibilities--TSGCEE Subgroup 9

(U) TSGCEE SG9 has the primary responsibility in NATO for reviewing the military requirements, identifying the potential impact on the OSI standards planned for use in each of the seven layers of the ISO and NATO Reference Model, defining the deficiencies and services required to address these requirements at each layer, and

developing draft STANAGs that conform to the Reference Model and provide for the needed services. SG9 has three permanent WGs, one of which is not permanent, and three ad hoc working groups (AHWGs):

- WG1, responsible for Layers 1-4 and functional profiles, within which the functional profile work is carried out by an AHWG on Functional Profiles.[37]
- WG2, responsible for Layers 5-7, within which the work on the Military Message Handling System (MMHS) is carried out by an AHWG on MMHS.
- WG3, responsible for establishing a memorandum of understanding (MOU) for a multinational programme for Communications Systems Network Interoperability (CSNI)--not a permanent WG; work on the MOU is expected to be completed in December 1990, at which time WG3 would be disbanded.
- AHWG on OSI Management (AHWG-OM).
- AHWG on Integrated Services Digital Network (ISDN).
- AHWG on Security.

TSGCEE SG9 maintains liaison with many NATO bodies and agencies, including ADSIA, TSGCEE SG11 (Tactical Communications), TSGCEE PG6 (Tactical Communications Systems for the Land Combat Zone--Post 2000), NATO Industrial Advisory Group (NIAG) SG6 (Compatibility of Naval Data Handling Equipment), ATCCIS PWG, and Allied Tactical Communications Agency (ATCA).

(U) SG9 has become increasingly concerned that its terms of reference (TOR) [Ref. 240] are too broad in nature and that because of resource limitations within the Nations there is a need to formally restate the TOR to reflect the direction of the work SG9 considers most valuable and within its ability to undertake. The proposal developed by the Chairman of SG9 stated the mission [Ref. 241]:

> To promote cooperation among NATO Nations in ensuring the technical interoperability of data processing and distribution systems used for command and control and in the development and procurement of related equipment and software.

Table 22 gives the specific actions for SG9 identified in the proposal (the proposed draft TOR will be discussed at the 11-13 December 1990 meeting of SG9). In a briefing to SG9 in May 1990, the Chairman of SG9 proposed the following strategy for SG9 to carry out the actions of Table 22 [Ref. 242]:

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37 (U) The AHWG on Functional Profiles has recommended that the content and structure of a NATO functional profile be based on ISO TR 10000. Review of this document shows that TSGCEE SG9 intends to specify recommended standards for multiple layers at the interoperability parameter level.

In terms of the NIMP, which advocates the use of civilian communications standards (ISO/OSI) for C3 systems (augmented for military features as necessary), TSGCEE is tasked to support this policy by undertaking the following:

(1) In conjunction with appropriate NATO agencies, determine the range of standards needed by functional name, type, application area, and time required over a forward time frame of 5 years.

(2) In light of the SG9 list of military features, determine their applicability to each identified need.

(3) From (2) estimate the resources needed to produce the standard in terms of effort, skills, and time frame.

(4) Clearly define SG9 contribution planned (e.g., no involvement, consultancy/review, guidance, or provision).

(5) Develop policy on forms of support to be given (e.g., on Base STANAGs, profiles, or Parts of STANAG 4250).

(6) Make explicit statements of external work needed.

(7) Define major work items: define responsible 'agents,' time, resources, and expertise.

Table 22. (U) Proposed Revised Special Tasking Instructions for TSGCEE SG9

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Subgroup 9 is required to undertake the following specific tasks:

- Sponsor and develop a Single Architecture of NATO Technical Common Interface Standards (SANTIS) structured in compliance with the ISO Basic Reference Model for OSI and in accordance with the policy approved by the TSGCEE at its meeting held from 13th to 15th December 1983. The architecture will be developed by using civil sector standards developed by ISO and related recommendations of CCITT, but with enhancements as necessary to provide military features.
- In the light of the approved policy and in consultation with ADSIA, review and support the development of the NIMP to include SANTIS.
- Give guidance to the [other] TSGCEE subgroups to ensure that those data transmission standards related to Layers 1 to 3 of the NATO Model, which are the responsibility of those subgroups to develop, conform to SANTIS.
- Review existing communications STANAGs for suitability for the SANTIS and for interoperability with that architecture.
- Identify STANAGs under development that deviate from the Subgroup's policy and, where practicable, influence them to conform to SANTIS.
- In consultation with ADSIA, submit recommendations to the TSGCEE on the role it should play in the formulation of test plans and procedures and in configuration management.
- Influence the further development of NATO digital data links to conform to SANTIS where desirable.
- Observe activities in appropriate research study groups of the Defence Research Group and make use of their results and recommendations in areas relevant to the work of the Subgroup.

(U) The following working documents and papers have recently been developed to refine the scope of TSGCEE SG9 work on using OSI standards for NATO CCISs:

- *Use of OSI Standards in NATO--Strategic and Technical Issues*, May 1990 [Ref. 243]
- *The TSGCEE Subgroup 9 Support Programme for OSI in Military Communications*, June 1990 [Ref. 244]
- *The Use of OSI in Military Communications*, June 1990 [Ref. 245].

(U) An AHWG has been formed by TSGCEE to review the current organization of TSGCEE and make recommendations for streamlining the organization. The AHWG is expected to complete its work in 1990. At the January 1990 TSGCEE plenary meeting, the TSGCEE directed that ATCCIS Phase III be included in these efforts [Ref. 246]. The recommendations of the AHWG, taken up at the June 1990 TSGCEE plenary meeting, included the formation of six Principal Subordinate Groups (PSGs), each of which could have subgroups, WGs, project groups, and AHWGs. Details of the recommendations are classified [Ref. 247]. However, it is possible that ATCCIS would be taken up by a project group or a subgroup other than SG9. TSGCEE decided in June 1990 to refer the recommendation on reorganization to the CNAD.

(U) The foundation for an assessment of the progress in NATO for adapting to and, where necessary, defining military enhancements for OSI standards is a review of the activity and work plans of SG9. The activity for developing the *NTIS Transition Strategy* is discussed in Section 10.3.1. This is followed by a discussion of the current activity and work plans of the three WGs of SG9: WG1 in Section 10.3.2, WG2 in Section 10.3.3, and WG3 in Section 10.3.4. Status of the current work of the three SG9 AHWGs is discussed next: AHWG-OM in Section 10.3.5, AHWG-ISDN in Section 10.3.6, and AHWG-Security in Section 10.3.7. Because of the scope of its work, the current activity and work plan of WG2's AHWG-MMHS is discussed separately in Section 10.3.8.

10.3.1 NTIS Transition Strategy

(U) A major project of TSGCEE SG9, led by the German delegation, is the development and maintenance of the *NTIS Transition Strategy*. The current version is the 1989 or Fifth Edition; it is dated 30 November 1989 [Ref. 4] and was directed to be distributed by SG9 in May 1990. This document is revised annually and promulgated by the CNAD. It provides recommendations for international commercial standards, primarily from ISO and CCITT, and intercept strategies (stacks of standards) that can be used by the nations as part of a transition strategy prior to the promulgation of OSI STANAGs. The *Intercept Profile for Military Message Handling Systems*, based on

CCITT X.400-MHS(84) (see Section 10.3.8), was included in this edition. The Fifth Edition also incorporates ISDN standards and the 1988 recommendations of CCITT. It describes 4 application, 17 transport, and 11 relay profiles. It also addresses many of the deficiencies identified in the July 1989 release (Version 1.2) of WP 25, including ODA, RDA, and TP. A summary of the standards and profiles contained in the Fifth Edition of the *NTIS Transition Strategy* is provided in Section 4.3.1, especially Tables 2, 3, and 4 and Figure 9. The profiles are illustrated in Appendix B.

(U) A draft of the next edition of the *NTIS Transition Strategy* is expected to be provided to the October 1990 SG9 meeting and distributed in final form after the May 1991 SG9 meeting. The new version will include use of the new ISO TR 10000 taxonomy. The taxonomy of application profiles is expected to be removed from the *NTIS Transition Strategy* and included in the Functional Profile Guidelines document being developed in WG1. Emerging standards not addressed in the Fifth Edition that should be considered for the next edition of the *NTIS Transition Strategy* are ODP, TM, security protocols, X-Protocol (X-Windows), GKS, CGI, PHIGS, CGM, SQL, IRDS, and Remote Call Procedure.

10.3.2 Status of Activities and Plans for Developing Lower Layer OSI STANAGs

(U) The two primary tasks of WG1 are developing lower layer STANAGs (the first issues are planned for submission to SG9 in October 1990) and developing guidelines for standardizing NATO functional profiles. The status of these activities is summarized below [Ref. 248-250].

10.3.2.1 Lower Layer STANAGs. (U) WG1 has agreed to prepare all the lower layer STANAGs for submission to SG9 by the October 1990 WG1 meeting. If possible, example profiles, Conformance Statements, and NPICS Proforma will be included. At present, the draft STANAGs do not explicitly require Transport Protocol TP4 to support connectionless operations, and they may not include the annex for Layer 3 (Annex F) on the connectionless Internet Protocol (IP). Revised drafts of all STANAGs are planned for the July 1990 meeting of the AHWG-FP. WG1 has determined [Ref. 251] that it is inappropriate for forward error coding (FEC) to be standardized with the OSI framework; therefore, WG1 has relegated FEC as actions to be accomplished on the information bit stream outside the Reference Model. Thus, FEC is not currently being considered in the lower layer STANAGs.

10.3.2.2 Functional Profiles. (U) A Functional Profile (FP) Guidelines document is being developed; it is viewed in WG1 as the basis for the lowest

common denominator of interoperability. This document is being developed in WG1, but WG2 will be requested to provide formal comments and will be invited to participate in future AHWG-FP meetings. The FP Guidelines document is based on ISO TR 10000 (Part 1--*Framework* and Part 2--*Taxonomy*). WG2 has no strong reservations against the FP Guidelines or the ISO TR 10000 taxonomy and structure for standardized profiles. However, WG2 expressed the need to continue their message handling work in the EWOS format in order to maximize their interchange of information with EWOS. WG2 would translate their MMHS STANAG work into the TR 10000 structure at a time when that structure was more stable for the upper layers. WG1 plans to submit the FP Guidelines document to SG9 in October 1990.

10.3.2.3 Use of OSI in NATO. (U) WG1 is evaluating a proposal to change the emphasis of WG9 work on military features. The paper, *NATO Approach to OSI--A Review,* says that

> With the possible exception of the work on management however, the analysis of the current ISO position indicates that there is relatively little scope remaining for NATO to influence ISO to provide specific military features.[38] Therefore, we need to focus our work on the facilities that are now present and examine how they should be adapted for use. ...there is a need now to develop augmentations to the civil standards.

WG1 agreed that work should be done to adapt present facilities for military use, but that many aspects of the identified military features cannot be satisfied by the present facilities and that additions must be made to the current protocol standards. WG1 further agreed that it is desirable to amend the civilian OSI standards under development to incorporate military features if that it is possible. Finally, WG1 agreed that this represents a shift in emphasis in the WG1 work, but not to the exclusion of having NATO-approved positions presented to ISO. The *NATO Approach to OSI--A Review* paper addresses the military features as shown in Table 23.

38 (U) This view is not shared by all of TSGCEE SG9; both the AHWG on Security and the AHWG on OSI Management are continuing to work to influence ISO to provide military features. In security, work is continuing to make the TCS conform to the eventual security protocol agreed by ISO---only the implementation would be unique to NATO.

Table 23. (U) Proposed New Emphases for TSGCEE SG9 Work on Military Features

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(1)	Multihomed and mobile systems. The routing protocols are deemed likely to meet the military requirements. Further work in NATO is needed to establish exactly how these protocols are to be used. Additionally, further study is needed for use of the Directory service, if adopted by NATO, to meet these requirements by providing a mapping to multiple addressees.
(2)	MPDT. ISO work on multi-endpoint connections is likely to be set aside. Support of this feature for time-critical applications could be considered along with the work on real- time and tactical communications, or it can be considered as a pan-layer topic in its own right. SG9 should therefore assume the responsibility for developing this work as an augmentation to civil standards as a minimum to define a broadcast facility for use when the physical media is inherently of a broadcast nature.
(3)	Internetworking. Work is needed to meet the military requirement for secure internetworking between connection based and connectionless environments.
(4)	Security. NATO is currently further ahead than ISO on security. The work to develop the Trusted Communications Sublayer (TCS) protocols, which are unique to NATO and outside of OSI as a matter of choice, must continue. Further work is required to develop the security functionality at the other layers identified within NOSA... Interaction with the civil standards community is anticipated.
(5)	Robustness and Quality of Service. Little work has been done in ISO on fully supporting QoS. ... Much excellent work to define the military requirements for QoS has already taken place but it needs to be refined and developed as augmentations to layer protocols. ... It is an area, like management, where input to ISO could be made if the topic is pursued there. ... At the sub-network level, robustness may be supported through exploiting facilities within the emerging ISO routing protocols.
(6)	Precedence and Preemption. The ISO protocols to convey precedence and pre-emption need augmentation to define the number of military levels and how they are signalled between the layers in a consistent manner.
(7)	Real-time. Studies are required to examine the protocol overheads associated with current profiles (e.g., MMHS over STAMINA). It may be necessary to cut down the OSI stack for some profiles (e.g., support of wide area networks).
(8)	Management. Work is required to identify, define, and register military objects that need to be managed by means of the emerging OSI management mechanisms.

Source: *NATO Approach to OSI--A Review*, UK Contribution to WG1, October 1989, NATO UNCLASSIFIED.

10.3.2.4 Multipeer Data Transmission (MPDT). (U) Work is progressing in the US Protocol Standards Technical Panel for multicasting; by August 1990, WG1 plans to have a report on how the US GOSIP would accommodate a Combat Net Radio (CNR) profile. Canada is working to keep MPDT alive in ISO and is coordinating other NATO-Nation input with ISO.

10.3.2.5 Lower Layer Addressing. (U) WG1 has been reviewing a number of technical papers on lower layer addressing. These include the *EWOS Technical Guide to OSI Layer 1 Through 4 Addressing* and a draft British Standards Institute guide for *The UK Scheme for the Allocation of ISO-DCC Format OSI Network Service Access Point (NSAP) Addresses*, which was used in the EWOS document as a reference for addressing in Layer 3. The US has submitted papers on

naming and addressing and on the compatibility of STANAG 4214 and US GOSIP Network Layer addressing. The UK has developed a rationale for Annex D of draft STANAG 4263 with the goal of resolving differences with STC in an addressing scheme.

10.3.2.6 Precedence and Preemption. (U) Since ISO restricts the Transport Layer levels of precedence to 15 by restricting use of one of the levels, WG1 agreed to reduce from 16 to 15 the number of levels of precedence that would be adequate at the Transport Layer.

10.3.2.7 Real-Time Programs. (U) WG1 has specific proposals for incorporating real-time aspects into the Layer 4 STANAGs. There are issues regarding these real-time services as to their conformance to OSI, differences from CCITT real-time work, and the interest of several nations in other efforts [e.g., US Manufacturing Automation Protocol (MAP) real-time work] as closer to OSI.

10.3.2.8 Glossary of Terms. (U) WG1 has developed a *Glossary for OSI Layers 1 Through 4*. WG1 is recommending to SG9 that SG9 coordinate a glossary for all OSI layers.

10.3.2.9 Liaison With Other Groups. (U) The *NATO Consultation, Command and Control (C3) Master Plan* developed by NACISA is being forwarded to the Military Committee and is expected to be approved. The *NATO C3 Architecture* is still being worked on; in particular, Volume 1 (*Consolidated Architecture*) has not been accepted (see Section 11.1). STC has an ongoing program to implement X.25 for an investigation of preemption functionality. US/EUROCOM wishes to use STANAGs 4262 and 4263 for the revised STANAG 4269 on the tactical digital gateway but reports that the layer STANAGs were not considered stable enough. WG1 has noted that the gateway standard would appropriately be a profile of SG9 lower layer standards, probably a relay profile. WG1 has responsibility for access to ISDN and plans on developing profiles for use of ISDN as a bearer service.

10.3.2.10 Work Plan. (U) TSGCEE SG9 WG1 has an 18-month work plan, beginning October 1989, that contains the work areas and planned activities on lower layer STANAGs as shown in Table 24 (the first five are most important areas; the work plan will be updated in October 1990) [Ref. 248, 250].

Table 24. (U) Work Plan and Activities on Lower Layer STANAGs by WG1

UNCLASSIFIED

(1)	Develop annexes to Layers 1-4 STANAGs, incorporating the applicable NATO military features; focus on MPDT and the TC 111(M) Profile, Connection-Oriented Transport Protocol (TP0/TP2) over X.25 (complete by September 1990).
(2)	Submit Layer 1-4 STANAGs to SG9 for ratification (October 1990).
(3)	Finalize and submit for ratification the Functional Profile Guidelines document for submission to SG9 in October 1990.
(4)	Finalize ongoing work on the TC 111(M) and R.131(M) functional profiles (drafts for July 1990; refer to SG9 after the September 1990 WG1 meeting).
(5)	Continue development of the TA SI(M) LAN profile (no target dates for completion).
(6)	Develop NATO military scenarios to provide a basis for future functional profiles, for use by all working groups (September 1990).
(7)	Develop addressing protocols.
(8)	Develop broadcast protocols (STANAGs) for tactical radios.
(9)	Develop STANAGs to support real-time communications.
(10)	Study gateways between tactical and strategic networks.
(11)	Study feasibility of ISDN in a NATO military environment (note: WG1 addresses only the requirements to access/interface to ISDN).
(12)	Study aspects such as use of routing protocols (especially with regard to multihomed and mobile host systems), multipeer (multi-endpoint) communications, internetworking, quality of service (including priority and preemption), and military-specific managed objects.
(13)	Maintain liaison with NIAG(SG6) in their development of functional profiles.

Source: *NATO SG9 WG1 18-Month Work Plan*, TSGCEE SG9 WG1, October 1989, NATO UNCLASSIFIED.

10.3.3 Status of Activities and Plans for Developing Upper-Layer OSI STANAGs

(U) The status of WG2 activities is summarized in the following paragraphs [Ref. 251, 252]:

10.3.3.1 Upper-Layer STANAGs. (U) The first issues of the STANAGs for the Session Layer, the Presentation Layer, and ASN.1 have been submitted to SG9 without any military enhancements. Some minor changes were made in February 1990. Some additional editorial changes were directed by SG9 in May 1990 and action to begin ratification was deferred. WG2 will make the required changes in October 1990, and the ratification process is expected to be directed to begin by SG9 in December 1990.

10.3.3.2 Registration Authority. (U) NATO needs to make provision for an appropriate registration authority to ensure unique addressing of military organizations and users within NATO MMHS domains and to assign object identifiers for MMHS (and other application service element) information objects. Registration authority can be technically independent for Application Layer addressing and information objects and for network addresses, but NATO may wish to consider these two issues concurrently.

(U) Two principal scenarios are being discussed, one in which NATO is registered as a network addressing authority under the ISO 6523 scheme and allocates Network Service Access Point (NSAP) address space to users, and another in which NATO is *not* so registered and each member nation allocates from its own delegated address space the NSAP address space for NATO use. It has been noted [Ref. 253] that if NATO becomes a network addressing authority, it will not prejudice the ultimate choice of which scenario to pursue and that such authority is needed for reasons other than NSAP addresses.

(U) SG9 has considered recommendations drafted by the AHWG on MMHS (see Section 10.3.8) put forward by WG2, but has decided to postpone action on this issue. SG9 decided to hold a meeting during 8-10 October 1990 with NACISA, national experts, and SG9 experts in attendance to formulate a method of work and joint recommendations for technical and administrative assessments on naming and addressing, and NATO as a registration authority [Ref. 254].

10.3.3.3 MMHS(88). (U) Revised working drafts of the MMHS(88) rationale, base standard, and two interoperability profiles have been produced. The current work is not yet stable (see Section 10.3.8). MMHS(84) gateways, directories, protocol implementation conformance statements (PICS), and management requirements still need to be considered. The June 1990 meeting of the AHWG on MMHS (in the US) addressed MMHS profiles.

10.3.3.4 FTAM. (U) WG2 has scheduled an initial focus meeting on FTAM for June 1990. The goals are: a statement on the current status of FTAM (including profiles and products); a requirements document outlining requirements for file transfer; determination of base standard and profile enhancements; and a work plan. WG2 plans to maintain close liaison with NACISA, particularly on the development of FTAM profiles, as NACISA has undertaken work in this area. NACISA is attempting to meet a requirement identified by the UK to transfer large unstructured files. Civilian profiles lack security features to support this requirement. NACISA plans to complete an FTAM profile for use over the STAMINA transport profile by September 1990.

10.3.3.5 Liaison with Other Groups. (U) WG2 has taken the position that it is premature to consider firm profile structures (WG1 FP Guidelines) at this time. The AHWG on MMHS is attempting to influence civil profile efforts, EWOS in particular, that have not adopted TR 10000, on which the WG1 draft Guidelines are based. WG2 is concerned about the deviation of the Quadrilateral Technical Interface Design Plan (QTIDP) project from the MMHS profile, the possible costs associated with altering

implementations based on the QTIDP work to be conformant with the MMHS profile, and the potential interoperability problems between systems implementing different profiles.

10.3.3.6 Work Plan. (U) WG2 has developed a 12-month work plan for the period February 1990 to February 1991. This plan addresses progress of MMHS and support for ratification of the Session, Presentation, and ASN.1 STANAGs. In addition it identifies: monitoring the status of conformance testing, upper layer security, directories, upper layer management, recommendations on NATO registration issues, and *NATO C3 Architecture;* providing a response to WG1 on Functional Profile Guidelines; developing well-defined requirements for Upper Layer military extensions; and developing a WG2 way forward and program of work for real-time requirements and FTAM. A summary of the elements of this plan is provided in Table 25 (the topics are alphabetical) [Ref. 255].

10.3.4 Nunn Initiatives and Work Plan of WG3

(U) An Ad Hoc Group on Nunn Initiatives was formed by TSGCEE SG9 in March 1988 to progress three projects as multinational cooperative efforts. In part, these proposals were aimed to satisfy a request from ADSIA to TSGCEE to investigate the feasibility of a transmission-media-independent data link architecture; such an architecture and the associated technical standards are needed to support stated requirements of the Air Command and Control System (ACCS, see Section 11.3). The three original proposals were to:

- Develop, test, and implement techniques for Communications System/Network Interoperability (CSNI)
- Develop an architecture for future data links based on the NATO Reference Model
- Produce draft STANAGs for the products produced in the other two projects.

NATO funds for the last two proposals have not been found.[39]

39 (U) US DoD support for the second and third items was not provided, apparently due to lack of funds.

Table 25. (U) Work Plan and Activities on Upper-Layer STANAGs by WG2

UNCLASSIFIED

(1) Abstract Syntax Notations. Develop STANAGs covering the use of abstract syntax notations (e.g., ASN.1) and their encoding rules. Ratification of STANAGs without military extensions has been recommended to SG9. WG2 will attempt to identify requirements for military extensions. Areas of analysis have been the use of ASN.1 versus NATO Message Text Formatting System (FORMETS), encryption, and compressed encodings.

(2) Application Layer STANAG Format. Develop a STANAG format to deal with Application Layer service and protocol specifications; this format (completed in March 1988) will form the basis for the development of separate service/protocol STANAGs such as for ACSE, FTAM, MHS, and Remote Data Access (RDA). This format will accommodate functional profiles. Functional profiles for an application will be ratified separately and included as annexes to the base STANAG for that application.

(3) Conformance Testing. Establish a framework and methodology for testing the conformance of protocol implementations of a particular standard. Specify test sequences to be used. A proposal by Canada in March 1989 was accepted by SG9 and is awaiting a TSGCEE decision on the allocation of funds and resources. The initial step would be a team of two or three persons developing detailed recommendations regarding the establishment of a permanent NATO testing organization, its structure, responsibilities, and relationship to other NATO bodies, agencies, and member Nations.

(4) Connectionless-Mode Data Transfer. Adopt or develop standards to support connectionless-mode service at both upper and lower layers of the reference model. International standards for the upper layers (e.g., ISO 9548, ISO 8326/AD1, ISO 8822/AD1) are now stable. No schedule for WG2 in this area has been set.

(5) Database Requirements. Determine military requirements for database management systems (DBMSs) and the potential applicability of ISO standards (from ISO SC21/WG3, such as NDL, SQL, SQL2, IRDS, and RDA; and from the activity of ISO SC21/WG1 on Distributed Application Processing and Transaction Processing) (see Section 6.2). Possibly develop a new STANAG dealing with database requirements. An issue is the area of responsibility vis-a-vis ADSIA with respect to NATO information architecture. No activity other than an STC presentation in March 1989 on database replication.

(6) Directories. Determine applicability of joint ISO/CCITT Directory standards (see Section 4.3.4) to the NATO communication systems environment. Given need for such standards, develop an Application Layer STANAG for Directory services. An ad hoc meeting was held in June 1988 to assess the impact of Directory standards on military communications networks. Further discussion is required but not scheduled.

(7) File Transfer. Add FTAM, with possible enhancement or modification, to the set of Application Layer STANAGs; determine what military applications FTAM might serve and how it might be adapted to, and used in, a military environment; and specify how required military features, such as security and quality of service, will be incorporated into FTAM for military use (see Section 4.3.3). An initial ad hoc meeting was held in June 1990. The results will be discussed at the October 1990 WG2 plenary meeting.

(8) Formal Description Techniques. Establish a standard within NATO for use of FDTs to describe protocol and service specifications and test sequences. Several different techniques are currently used in the civilian area [SDL by CCITT, ESTELLE and LOTOS by ISO, and Tree and Tabular Combined Notation (TTCN) for test sequences in ISO and CCITT] (see Section 8.5). A requirement exists for some uniformity in both FDTs and the automated tools to support them. No activity to date.

(9) Graphics. Determine the need for graphics within the NATO context and the relevance of ISO standards such as GKS and PHIGS (see Sections 9.2.3) or standards such as Videotex and CCITT T.73 (mixed mode); determine the need for including such standards into appropriate segments of Application and Presentation Layer STANAGs. No activity to date.

Table 25. (U) (Continued)

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(10) MMHS. Add MOTIS service and protocol specifications and CCITT X.400 MHS-series recommendations, or parts thereof, with possible enhancement or modification; determine what military applications electronic mail might serve and how it might be used in a military environment; and specify how military features, such as security and quality of service, will be incorporated into MOTIS/MHS. See Section 10.3.8 for details of MMHS work areas by WG2.

(11) Multipeer Data Transmission. Determine military requirements for MPDT and the potential modification or creation of protocols for this task. Intermittent activity, but no resolution for further action. ISO initiated a project on this topic but suspended it due to lack of support. This pan-layer issue may eventually dictate changes to upper layer STANAGs.

(12) Naming and Addressing. Define a universal scheme for the naming and addressing of layer entities, with particular emphasis on the Application Layer. Such a scheme is necessary for interoperability of application entities that are attached to different subnetworks and may be mobile (i.e., may temporarily detach from and reattach to different subnetwork points of attachment). Examine the need for a registration authority within NATO to ensure globally unique names and addresses. WG2 has made specific recommendations (see Section 10.3.8) to SG9 that NATO become an authority for Application Layer registration.

(13) NATO C3 Architecture. Monitor the direction and possible impact of activity in this area. Receive informal briefings. Maintain liaison with NACISA.

(14) Presentation Layer STANAGs. Develop STANAGs to encompass the OSI Presentation Payer services and protocol specifications (ASN.1 is being addressed as a separate STANAG). Ratification of STANAGs 4256 and 4266 without military extensions has been recommended to SG9. The WG2 questionnaire did not identify requirements for military extensions in the short term.

(15) Quality of Service. Determine special military requirements for quality of service; these could be general (e.g., performance requirements) or layer specific. Monitor work by the AHWG on OSI Management. This is a pan-layer issue that may dictate changes to upper layer STANAGs.

(16) Real-Time Performance. Determine special military requirements. No activity other than a presentation in October 1989.

(17) Session Layer STANAGs. Develop STANAGs that encompass the OSI Session Layer service and protocol. Ratification of STANAGs 4255 and 4265 without military extensions has been recommended to SG9. The WG2 questionnaire did not identify requirements for military extensions in the short term.

(18) Upper Layer Architecture. Determine functionality required for NATO systems with respect to Upper Layer Architecture. This activity is designed to ensure maximum uniformity between different OSI application service elements (e.g., FTAM, MHS). No activity other than one report.

(19) Upper Layer Management. Determine functionality required for NATO systems. No activity to date. A report on the US Defense Message System management is planned.

(20) User Requirement Definition. Conduct a questionnaire to survey user requirements for Session and Presentation Layer deficiencies identified in the September 1988 Canadian analysis. Questionnaire was revised and circulated to Nations in May 1989. No requirements for specific changes in upper layers were identified. A recommendation to pursue FTAM was noted (see above).

(21) Virtual Terminal. Consider the potential use of civil Virtual Terminal work in a military context. No activity to date.

Source: *NATO SG9 WG2 18-Month Work Plan*, TSGCEE SG9 WG2, May 1990, NATO UNCLASSIFIED.

10.3.4.1 WG3 on Communications System/Network Interoperability (CSNI). (U) WG3 was formed in October 1989 to develop an MOU under a Nunn Initiative for CSNI. Canada, France, and the United States have signed the formal Statement of Intent for participation; the UK, NL, and STC have also expressed interest in participating. WG3 tasking will end with a completed MOU among the participating nations, but the project itself will take about 3 years. The emphasis of this 3-year effort is not on developing standards but rather to demonstrate the operational utility of internetworking using enhanced OSI profiles with military features. While completion of the MOU is planned for December 1990, the Chairman of SG9 has suggested that WG3 be kept as an AHWG within SG9 [Ref. 256].

(U) The CSNI project plans a demonstration in 1993 for linking subnetworks of countries across long haul multimedia supporting multiple modes (voice, data, images). According to the January 1990 draft MOU [Ref. 257], WG3 will (1) ensure that the work will be closely related to the recommendations, standards, and draft STANAGs of all groups under SG9; (2) provide both feedback into the STANAG development process and practical experience on the implementation of OSI protocols on military bearer systems; (3) provide reports on the demonstration results and performance to SG9; and (4) based on demonstration results, recommend to SG9 the adoption of promising system concepts for different operational applications. An outline of the work areas being considered for the CSNI statement of work is given in Table 26.

Table 26. (U) Proposed Work Areas for CSNI in WG3

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1. System Concepts and Testing
   a. System demonstration architecture
   b. Testing program
2. Applications and Services
   a. Database exchange
   b. Security
   c. Voice
   d. Messaging
3. Multinetwork Management and Protocols
   a. Multimedia routing
   b. Enhanced OSI protocols
4. Communications Media and Systems
   a. Long haul HF
   b. Satellite communications (SATCOM) SHF
   c. SATCOM UHF
   d. MIDS and X.25
   e. Internet
   f. VHF
   g. UHF LOS.

Source: *Draft Proposed Terms of Reference for WG3*, TSGCEE SG9 WG3, 22 January 1990, NATO UNCLASSIFIED.

10.3.4.2 Media-Independent Data Link Architecture (MIDLA). (U) MIDLA was suggested to TSGCEE by ADSIA in 1986 [Ref. 258]. During the period 1987-1989, the Nations attempted to identify Nunn Initiative funding for MIDLA, but these efforts were unsuccessful. At the October 1989 SG9 plenary meeting [Ref. 251], the Nations agreed that development of a data link architecture based on the OSI Reference Model to replace antiquated data links was extremely important. However, it was also agreed that resources were not available within SG9 to address the breadth, complexity, and technical aspects of that subject. SG9 agreed to send a letter to TSGCEE stating the importance and magnitude of this project. In addition, the Nations were asked to assess again the availability of resources relative to the MIDLA project.

(U) Some bilateral work between France and the United Kingdom is being discussed regarding future data link architectures. Further, ADSIA has received an STC study, *An Architecture Based on OSI Principles for NATO Tactical Data Links* [Ref. 259], and has indicated to TSGCEE SG9 that no further work on behalf of ADSIA is required for MIDLA [Ref. 260]. However, tactical data link architecture is being addressed by the TSGCEE AHWG on Restructuring as a potential area of work. SG9 has indicated that if the SG9 terms of reference are amended to include tactical links, guidance from the TSGCEE would be required on providing necessary resources [Ref. 256, 261].

10.3.5 Status of Activities and Plans for Developing Network Management Standards

(U) The lead for NATO initiatives on network management is the AHWG-OM, which addresses such pan-layer areas as fault management (detection, isolation, and correction of abnormal operation); configuration management (exercise control over identities and collect data from and provide data to managed objects in order to assist in providing continuous operation of interconnection services); security management (enable the management of the information necessary for providing security services); accounting management (enable charges to be established, and costs to be identified, for the use of managed objects); and performance management (evaluate the behavior of managed objects and the effectiveness of communication activities). Specifically, the AHWG-OM was established to:

- Define the requirements for management in a military OSI environment.
- Investigate the influence of the military features (see Section 10.2) on the OSI management standards under development by ISO. The AHWG-OM has determined that the eight military features will affect, to varying degrees, all management areas.
- Influence ISO, and other standards bodies as appropriate, to adopt any additional military features identified.
- Develop any additional military management standards for the requirements not met by ISO.
- Assist in the coordination of management work within NATO and provide support for OSI management to SG9 and its working and ad hoc groups.

(U) The work of the AHWG-OM has been focused on influencing ISO work; in addition, work has begun on a draft STANAG covering OSI management. Many members of the AHWG-OM are also members of ISO committees, and the AHWG-OM believes its work is recognized by ISO in SC21/WG4 as a major contribution of the development of standards [Ref. 262].

(U) Many of the ISO network standards have been reorganized and now appear to have a stable framework in ISO (see Section 8.2.3). A new set of functions has been developed, and the model of management information has been significantly modified. The Common Management Information Service (CMIS) and Protocol (CMIP) are now International Standards (ISO 9595 and 9596).

(U) The AHWG-OM has noted that little military influence has yet been brought to bear on Security Management, for which work is progressing very slowly in ISO. The responses to a requirements questionnaire distributed in June 1989 indicated

that almost all network management practices were manual and procedurally oriented and were not relevant to what ISO is trying to standardize in Network Management. However, the results of the questionnaire confirmed the earlier military analysis document in the Working Document *NATO Requirements for OSI Management* (an evolving record/base document of the AHWG on OSI Management results) [Ref. 263]. Enhancements to this document--specifically in Section 7, "Military Features and Their Impact on OSI Management"--arising from the questionnaire were adding the needs (1) for a broadcast facility, (2) for a capability to apply management in real time, (3) to define and work across management domains, (4) to define access control mechanisms for management information, and (5) to provide for survivability of management information (replication mechanisms). Requirements for performance management, event reporting, and management negotiation were dropped [Ref. 264].

(U) In the February 1990 AHWG-OM meeting a formal contribution, addressed from individual nations to ISO, was drafted requesting adoption of Quality of Service (QoS) as a new work item by SC21/WG1, in response to Question Q62 on QoS. If QoS is accepted, the AHWG-OM will need to concentrate on the management-specific aspects of QoS, especially notifications.

(U) The AHWG-OM has a prioritized 21-month work plan [Ref. 262] from June 1990 through February 1992. Work on military features, broadcast, and the out-of-band Telecommunication Management Network (TMN) for ISDN was conducted at the June 1990 meeting. The remaining 1990 meetings will emphasize Quality of Service and Parts 4 (Management) and 5 (Military Features) of Edition 2 of STANAG 4250, as well as a three-volume *Management Guide*[40] to provide guidelines on the definition of NATO-managed objects. For QoS, an input paper will be developed and provided to the Nations for national input to ISO. Drafts of Part 4 to STANAG 4250 and Volume 1, *Introduction and Overview,* of the *Management Guide* was developed and distributed to other working groups in June 1990; these will be revised and forwarded to SG9 in October 1990. These documents will be finalized for ratification at the February 1991 meeting. Volume 2, *Applying OSI Management,* and Volume 3, *Product Procurement and Considerations,* of the *Management Guide* will be finalized by the October 1991 meeting. Updates of the Working Document will continue, with emphasis on changes made to Section 7.

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[40] (U) The full title of the *Management Guide* is *NATO Systems Guidelines for the Use of OSI Management.*

10.3.6 AHWG on ISDN

(U) An AHWG on ISDN was formed by TSGCEE SG9 in 1989 to review the status of ISDN and the applicability of these standards to NATO. The terms of reference are shown in Table 27. An overview of the eight military features was adopted at the April 1990 meeting. The results are given in Table 28 (note that the suitability of the ISDN protocols for use in the tactical domain was agreed to be outside the scope of the meeting) [Ref. 265].

Table 27. (U) Initial Approach to Military Features for ISDN

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(1)	Identify the ISDN domains to be standardized to assist the development of consistent ISDN standards within NATO countries and, in addition, to fulfill interoperability requirements and facilitate the development of a NATO Communications Subsystem.
(2)	Identify ISDN civil standards applicable to the systems involved in a NATO Communications Subsystem.
(3)	Review the capability of ISDN to support relevant military features, interworking requirements from tactical users/networks, and other NATO user service requirements.
(4)	Consider specifying enhancements to ISDN civil standards to meet a minimum military requirement.
(5)	Determine the impact of ISDN on the NTIS defined by SG9 in accordance with the NATO Reference Model, for example, the NTIS on network management and security.
(6)	Submit technical papers to SG9 for candidate profiles and/or STANAGs.
(7)	Submit a report to SG9 at each meeting.

Source: *Terms of Reference for TSGCEE SG9 AHWG on ISDN,* NATO UNCLASSIFIED.

Table 28. (U) Military Features for ISDN

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(1) Mobile Hosts and Multihomed Systems. A number of scenarios are being discussed, some outside the ISDN domain (e.g., in the tactical area) and some within the strategic ISDN domain (e.g., as user moving from one PABX to another). Only strategic ISDN domain issues are currently being addressed in the AHWG on ISDN. It was agreed that ISDN Suspend/Resume procedures for moving during a call were not applicable to mobile hosts. Some form of slow mobility is required where a user may, for example, move between extensions on the same access switch or even to a different access switch and still maintain the same user identify. This would require a type of registration and cancellation procedure where a user takes the user identity around a fixed network. Specific NATO procedures may be required to realize this feature--further study is required. Procedures associated with the cellular radio service are issues mainly applicable to the tactical domain.

(2) Multi-Endpoint Connections. Information needs to be multicast (or broadcast) to several destinations. A central issue is whether a unidirectional service was required for this feature:

(a) If the requirement were defined in terms of a conference call (bidirectional), then commercial products are expected to be available.

(b) If broadcast facilities were provided at the Application Layer using packet procedures, no specific NATO procedures are required.

(c) If broadcasting were required on all bearer services (e.g., voice and data), then the AHWG on ISDN should wait for CCITT/ETSI to define this feature.

It was generally agreed that the multi-endpoint feature is for data application rather than voice; further study is required on the requirement for voice.

(3) Internetworking. The *NATO C3 Architecture* (Volume 4, *Communications Subsystem*) allows both the "T" reference point and the K, M, and N reference points as possibilities for internetworking. If the "T" reference point were chosen, then a number of enhancements would be required for NATO, such as satellite and routing indicators.

(4) Network and System Management. CCITT is defining a network management structure in both the user-network area (Q.940) and within the network. This work is at the architectural level and has not resulted in a definition of detailed procedures. Of particular interest to SG9 are the management functions of Section 3 of Q.940 for fault, configuration, accounting, performance, and security management--all aligned with OSI management functions. In addition, management reference models have been defined.

(5) Security. Key issues are the applicability of NOSA to ISDN (for data services), the impact of ISDN on NOSA (e.g., security of voice services, protection of signalling channels), and the definition of new security features using ISDN capabilities (e.g., common channel signalling). The first two issues are for the AHWG on Security. The AHWG on ISDN will propose ISDN security features relevant to the third issue (e.g., supplementary services) for approval by security experts of SG9.

(6) Robustness and Quality of Service. The only possible special NATO requirement identified is the QoS parameter, should the ISDN network performance figures given in I.350 not prove to be adequate for military applications.

(7) Precedence and Preemption. This feature is already being addressed (service definition and information).

(8) Real-Time and Tactical Communications. No special real-time requirements are foreseen for ISDN. Note that the discussion was limited to interworking with a tactical network and to the concept of a strategic ISDN activity either as a transit network or to gain access to an ISDN user.

Note: The suitability of the ISDN protocols for use in the tactical domain was agreed to be outside the scope of the assessment leading to these requirements.

Source: *Report of the 2nd Ad Hoc Meeting on ISDN, Paris, 24-26 April 1990*, TSGCEE SG9 AHWG on ISDN, May 1990, NATO UNCLASSIFIED.

(U) The AHWG on ISDN is discussing the ISDN Reference Model and has considered papers from France (based on the CCITT Reference Model and the *NATO C3 Architecture*), ETSI, and ECMA. These models describe network-to-network interworking, including CCITT No. 7 and QSIG (an extension of Q.931) protocols.

(U) Discussion of essential bearer services for ISDNs used for NATO communications resulted in a two-page recommendation for the Network Bearer Services [viz., 64-kbps circuit switched (CS) unrestricted as in I.231.1, CS speech as in I.231.2, CS 3.1 kHz audio as in I.231.3, CS access to packet switching node as in I.231.1, B-channel packet switched access as in I.232.1, and D-channel packet switched access on the Basic Rate Interface as in I.232.1] and the Terminal Bearer Services. Further study has been recommended for Frame Relay (I.122), Frame Switching (I.122), user-to-user signalling (I.232.3), 7 kHz audio, 2x64 kbps unrestricted, H0--384 kbps unrestricted, H11--1536 kbps unrestricted, and H12--1920 kbps unrestricted.

(U) One proposal (submitted by the US) suggests the following as the basis for a draft STANAG on ISDN for packet mode services [Ref. 266]:

- Networks shall support a packet-switching capacity in conformance with the 1988 CCITT recommendation on packet-switched data, X.31/I.462, *Support of Packet Mode Terminal Equipment by an ISDN*. At the user interface for the Basic Rate Interface, both B channel and D channel packet switching will be supported. At the Primary Rate Interface, B channel packet switching will be supported. Terminals that support X.25-based packet switching will also conform to X.31.
- Conditional notification shall be supported on switched access connections. On permanent virtual circuits, the option of "no notification" shall be available.

(U) The issues identified in Table 29 have been recommended to be the focus of future efforts in the AHWG on ISDN (but have not been adopted) [Ref. 267].

Table 29. (U) Initial Draft Proposed Work Plan and Activities on ISDN

UNCLASSIFIED

(1)	Work on progressing the layer integration of the OSI Transport Service with the ISDN Digital Access Signalling System
(2)	Develop and provide directory capabilities for resource identification and selection, to include an Application Title Directory and a Network Address Directory, based on ISO 9594 (CCITT X.500)
(3)	Add naming and addressing issues with respect to ISDN to the SG9 working group pursuing these issues
(4)	Adopt the CCITT Common Channel Signalling System No. 7 (SS7) internationally
(5)	Study further tactical communications support by ISDN, with special attention to interconnection with digital radio and cellular networks and to the requirements for maintaining radio silence (e.g., unacknowledged data transfer)
(6)	Address (in the appropriate SG9 working groups) security and system management services as they pertain to ISDN and the coordination of ISDN and OSI Registration Authority issues
(7)	Accelerate the cooperation between ISDN and OSI standardization and planning efforts
(8)	Address the capabilities of B-ISDN to meet the minimum military requirement and consider viewing B-ISDN as the focus for future telecommunications services
(9)	Resolve the issue of interconnecting TCS "black boxes" to ISDN (TCS interfacing to ISDN needs further study)
(10)	Pursue the resolution of ISDN and OSI harmonization in NATO through direct involvement in established working groups within each individual nation, making these groups aware of NATO needs to promote military requirements.

Source: *ISDN/OSI Integration: Issues, Trends, and Recommendations*, Contribution from Canada to the Initial Meeting of the AHWG on ISDN, January 1990, NATO UNCLASSIFIED.

10.3.7 AHWG on Security

(U) The AHWG on Security has developed three major references for use in SG9: *NATO OSI Security Architecture (NOSA)* [Ref. 110], *Security Architecture for NATO Information Systems Interconnection (SANISI)* [Ref. 111], and the *NATO Network Security Information Classification Guide* [Ref. 122]. NOSA was developed to give guidance to contractors and procurement managers on the preferred placement of security services within OSI-conformant systems. SANISI provides detailed rationale on the placement of security services and mechanisms within the OSI Reference Model. A key element of SANISI is the requirement in Layer 3 for a Trusted Communications Sublayer (TCS). NOSA and SANISI do not identify a requirement for security protocols for Layer 4.

(U) Two security protocols (SP3 and SP4) have been introduced into ANSI from the US Secure Data Network System (SDNS) [Ref. 251]. SP4 has been accepted as a work item in SC6/WG4 in ISO, and SP3 is expected to be accepted when some additional work on SP3 is completed in 1990. SP3 is the protocol most closely aligned with TCS. Since the distribution of NOSA and SANISI, the AHWG on Security has been addressing questions regarding the security protocols that have been introduced

for Layer 3, including SP3, Northern Telecom's SPX, and the UK's End-to-End Security Protocol (EESP). SP3 was judged as equivalent to the end-to-end encryption portion of the TCS. SPX adds connection-oriented service to SP3. The EESP adds CO services to SP3 and includes integrity and traffic padding.[41] The AHWG on Security anticipates that SG9 should be able to arrive at a Layer 3 protocol that will satisfy NATO military requirements [Ref. 268].

(U) Discussion of SANISI has included proposed annexes on application and implementation aspects of the TCS and the Denial of Service definition. Agreement has been reached that once an event object is defined, the recovery mechanisms are the same whether the cause was malicious or accidental and so is a management issue. A review is to be conducted of the SANISI annexes to determine if these can be downgraded to NATO UNCLASSIFIED and be permitted to be used as technical input to ISO.

(U) The AHWG on Security is reviewing and maturing concepts of an ISDN security architecture. The AHWG has noted that the *NATO C3 Architecture* (see Section 11.1) underlines the importance of becoming aware of the security problems associated with an architecture that combines circuit switching with packet switching handling real-time voice and high-bandwidth data. A paper has been developed on security management; it will be condensed and included as Annex D in the NOSA document.

(U) The AHWG has expressed strong support for the WG3 program to demonstrate the proof of concept of the security protocols and architecture. The AHWG on Security has noted concerns that have been expressed that SDNS SP4 is not a suitable candidate from a NOSA point of view, as NOSA does not identify a requirement for security services in the Transport Layer. A recommendation was drafted that WG3 consider the concept of a TCS as in NOSA and SANISI. The TCS services definitions and protocol specification are not yet complete, but will be sufficient to provide the required security services within the next 12 months.

(U) The AHWG on Security held a meeting of security experts in June 1990 to discuss the TCS service definition and protocol specification. Progress was made on providing the additional technical work required for a detailed design specification for the TCS. This specification will be provided to the SG9 WGs for consideration and, in the case of WG3, possible implementation.

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41 (U) EESP was introduced into SC21/WG1 during the May 1990 meeting in Seoul. EESP has been proposed to the JTC1 as a new work item.

(U) The current 18-month work plan, shown in Table 30, has been focused to allow the AHWG to concentrate on the aspects of the security problem most visible in ISO, namely the Layer 3/Layer 4 security protocol. The AHWG believes that it is in this area where it has the greatest expertise and the best possibility of influencing ISO to adopt a standard suitable for NATO. The goal would be host protection, in addition to link protection. The next step will be application protection.

Table 30. (U) Work Plan for AHWG on Security

UNCLASSIFIED

(1)	Prepare glossary of terms
(2)	Consider registration authority issue
(3)	Review ISO activities on security
(4)	Analyse relation of ISDN and TCS
(5)	Review TCS Service and Protocol documents
(6)	Prepare TCS issues document for meeting of experts
(7)	Provide comments on NATO C3 Architecture
(8)	Edit and review classification of NOSA and SANISI texts
(9)	Update document on Security Management managed objects
(10)	Review upper layer security issues
(11)	Develop rationale for TCS placement

Source: *Agenda for 10-13 September 1990 Meeting of AHWG on Security*, 24 May 1990, NATO UNCLASSIFIED.

10.3.8 Status of Activities and Plans for Developing the Military Message Handling System (MMHS) for NATO

(U) During the last 3 years, an AHWG on MMHS, reporting to TSGCEE SG9 WG2, has been working to have features required by the military incorporated into the MHS defined by international standards bodies. The initial proposals, based on X.400-MHS(84), for an MMHS have been accepted as an Intercept Profile by SG9; it addressed security, confidentiality, integrity, authentication, message stores with access protocols, and directory services. Most of these features have now been incorporated in CCITT X.400-MHS(88). Known as the "Blue Book," MHS(88) was ratified in November 1988.

(U) MMHS will be addressed in a separate Application Layer standard, STANAG 4257; the first working draft of this STANAG was provided to WG2 in February 1990. STANAG 4257 will incorporate four elements that are being developed simultaneously by the AHWG on MMHS: Base Standard [Ref. 269], Rationale [Ref. 270], an Alpha Profile, and a Beta Profile. The Alpha profile is intended to address

strategic and tactical applications where bandwidth limitations are not severe, and the Beta Profile is intended to address tactical applications where bandwidth is severely limited. For the Beta profile, the AHWG on MMHS assumes that bandwidth will be conserved by eliminating all but the most vital services of MHS. These profiles are being written as a "delta" or change to the MHS profile being developed by the European Workshop for Open Systems (EWOS) [Ref. 271]. Each MMHS profile will be included in STANAG 4257 as a separately ratifiable annex [Ref. 272].

(U) The AHWG-MMHS work has been separated into two sets of functional groups. The first set consist of military messaging services, notification, security, redirection, distribution lists, conversion, ACP 127, and MMHS(84) gateways. The second set will provide directories, message store, physical delivery, management, routing, local services, and PICS. The first draft of the MMHS(88) STANAG [Ref. 269] released in February 1990 addresses the first set of functional groups.

(U) One of the key issues for MMHS is the need for NATO-wide consistency and uniqueness of names and addresses to be in conformance with international standards. WG2 made the following recommendations developed by the AHWG-MMHS to SG9 in May 1990 [Ref. 273]:

- Register NATO as a country name with ISO. If this is not acceptable to ISO/CCITT, then NATO should be registered as an Administrative Management Domain within one country (e.g., Belgium).
- Obtain a number for NATO as an Identified Organization in the object identifier structure detailed in ISO 9834.
- Establish a NATO registration authority to register the addresses of end users within NATO management domains (both domain names and the domain-specific part), to register Application process names and Presentation addresses, and also to manage the allocation of numerical subscripts to objects.

In June 1990 the AHWG on MMHS reviewed these recommendations in light of additional information provided by STC. MMHS has now withdrawn the above recommendations and plans to study the requirements and alternatives in detail at the October 1990 meeting.

(U) The *Intercept Profile for MMHS*, based on MHS(84), has been amended (Issue 2) to include full support for ACP 127 [Ref. 274]. It was completed in February 1990 and is ready for distribution by SG9. Issue 2 has a new annex (Annex C) on implementation options for the military header extensions. Issue 1 of the profile was accepted as an intercept strategy for the 1989 (Fifth) edition of the *NTIS Transition Strategy* [Ref. 4]; however, depending on choices of interoperability parameters, MMHS

implementations based on MHS(88) may not be backwards compatible with MHS(84) implementations (see Section 4.3.2.3).

(U) One area of MMHS not addressed by MHS(88) is support for trusted functionality. Such support may be covered by standards developed by the SDNS security protocols SP3 and SP4 to carry out services associated with trusted functionality. The May 1989 meeting of the AHWG-MMHS was devoted to security and succeeded in developing two functional groups of security services. One of these does not require use of asymmetric encipherment mechanisms, but precludes direct support of nonrepudiation services. These have both been accepted by EWOS. The AHWG-MMHS is seeking guidance from the AHWG on Security to identify suitable encipherment mechanisms to support these services [Ref. 275]. The AHWG on Security confirms the need for asymmetric cryptographic mechanisms and indicates that such mechanisms must be offered by the Nations for consideration and approval by the appropriate NATO authorities [Ref. 276].

(U) A number of MMHS-related issues are identified in the WG2 12-month work plan. These include editing and publishing the MMHS(88) Base Standard, Alpha Profile, Beta Profile, Rationale, overview statement (planned for September 1990), and statements of requirements for registration, security, management, and directory; specifying conformance requirements (postponed until 1991); specifying implementation guidelines for MMHS and for Directory support of messaging domains including MMHS and ACP (commencing June 1990); defining military extensions and methods for distribution lists; developing an evolutionary strategy; developing an MMHS(88) profile; developing MMHS management issues and requirements to be forwarded to AHWG on OSI Management (February 1991); defining the role of a Message Store in support of mobile hosts, plus extensions of civilian services to access the Message Store (June 90); defining MMHS naming conventions for upper layer OSI information objects such as application processes, abstract systems, transfer syntaxes, and application contexts; and developing a security model, security profile, and T-profile.

(U) Table 31 provides a statement and status summary of the work areas for MMHS being addressed in the 12-month work plan of the AHWG on MMHS for the period March 1990 to February 1991 (order of entries is alphabetical) [Ref. 277].

Table 31. (U) Work Plan and Activities on MMHS

UNCLASSIFIED

(1) Applications. Develop a guide to applications supported by MMHS. No activity to date.

(2) Base STANAG (MMHS(88)). Develop an MMHS STANAG based on CCITT X.400-1988, with extensions to meet military requirements. Activity commenced in January 1989 and is expected to be released to the Nations for comment after the June 1991 AHWG-MMHS meeting. The complete STANAG will be written as a "delta" document to the EWOS MHS profile. This means that instead of specifying the complete standard, it will only specify the changes to the EWOS document. It will consist of a Base Standard (which describes all the Elements of Service, rationale, default values, etc.), an Alpha profile for use in normal circumstances, and a Beta profile (which will exclude all but the essential services for message passing) for use in an environment of restricted bandwidth.

(3) Conformance Requirements. Specify conformance requirements and testing procedures for MMHS products and implementation. Postponed pending completion of the first draft MMHS base STANAG.

(4) Directory Guidelines. Specify implementation guidelines for Directory support of messaging domains, including MMHS and ACP 127. Begun June 1990.

(5) Distribution Lists. Define military extensions and methods for Distribution Lists. Main issues have been identified and documented in the working drafts of the base standard and profile.

(6) Evolution Strategy. Develop a full plan for specifying time frames for interconnecting MMHS, ACP 127, and civilian MHS domains and for including MMHS(88) features. Commenced January 1989, but no activity since.

(7) Implementation Guidelines. Develop implementation guidelines for MMHS based on MMHS operating procedures; include gateway issues. Discussion but no report to date. (Target for draft document was February 1990.)

(8) Local Services. Develop guidelines for common local services. Started work in June 1990; draft planned for September 1990.

(9) Management Issues. Develop MMHS requirements to be forwarded to the AHWG-OM. Started work in June 1990; draft planned for September 1990. Target publication date is February 1991.

(10) Mapping to Eight Military Features. Map the MMHS requirements to the eight military features. One contribution has been made; further work is pending resolution of the features themselves.

(11) Message Store. Define role of the Message Store in support of mobile hosts, plus extensions of civilian services to access the Message Store. Started work in June 1990; draft planned for September 1990.

(12) MMHS Intercept Profile ('84). Maintain an interoperability profile based on MHS(84) for use until the MMHS STANAG is mature. Version 2 was completed in February 1990 and provided to SG9 for publication. It is expected to appear in the next (Sixth) edition of the *NTIS Transition Strategy*.

(13) Naming and Registration. Define MMHS naming conventions for upper layer OSI information objects such as application processes, abstract syntaxes, transfer syntaxes, and application contexts. Establish registration authority (or authorities) and define registration procedures for names requiring registration. Deferred to SG9 for direction; recommendations forwarded by WG2 to SG9.

(14) Physical Delivery. Scope and produce guidelines for physical delivery. No activity to date.

(15) Routing. Define algorithms and constraints. Started work in June 1990; draft planned for September 1990.

(16) Security Model. Define a general architectural model for MMHS security services and mechanisms. List of outstanding issues created. Security parts of profile identified.

(17) Security Profile. Develop an MMHS security profile based on MHS(88) security services, plus additional algorithms, support systems, and procedures. Document underdevelopment based on EWOS profile A/3311 plus additional issues. Draft base STANAG [Ref. 269] and profile produced. Guidance of Nations sought on acceptability of security mechanisms.

Table 31. (U) (Continued)

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(18) T-Profile. Define a Transport Layer implementation profile for MMHS. Deferred to WG2.
(19) Testing Issues. Identify testing requirements and develop conformance and interoperability tests. Deferred to SG9 for direction.
(20) Transition Guidelines. Define transition strategy from intercept interoperability profile to final MMHS STANAG and functional profiles. Draft MMHS over paper produced that includes migration of ACP 127 and MHS to MMHS.
(21) User Requirements. Define user requirements to be met by MMHS functional and interoperability profiles. National inputs received from questionnaire in January 1989. No other activity planned.

Source: *MMHS AHWG Input to NATO TSGCEE SG9 WG2--12-Month Work Plan*, TSGCEE SG9 WG2 AHWG on MMHS, February 1990, NATO UNCLASSIFIED.

10.4 Status of NATO OSI STANAGs

(U) Table 32 identifies the STANAGs being developed that will specify ISO standards and applicable military options and extensions, if any. Work has begun on all these STANAGs, but only the NATO Reference Model, STANAG 4250, has been ratified. Originally, TSGCEE SG9 planned to issue a single STANAG for all services and a second STANAG for all protocols at each layer, giving a total of 14 STANAGs in addition to STANAG 4250, the NATO Reference Model. In October 1987, TSGCEE SG9 agreed [Ref. 238, Annex 1.2] to work at the Application Layer for single STANAGs for each Application Layer service, such as MMHS (STANAG 4257). Protocol specifications as well as service definitions would be addressed in that STANAG. This approach will require editorial changes in STANAG 4250.

(U) When stacks of standards, options, and interoperability parameters that involve more than one OSI layer are selected for open systems interconnection for NATO data processing and distribution systems, the agreements will be specified in documents that are to be known as functional profiles. NATO functional profiles, initially to be drafted by TSGCEE SG9, will be based on the OSI STANAGs 4250-4259 and 4261-4266. To date, the functional profiles promulgated by TSGCEE SG9 are contained in the *NTIS Transition Strategy* and are all based on commercial international OSI standards and the OSI STANAGs. These profiles (application, transfer, and relay) are identified in Tables 2, 3, and 4 of Section 4.3.1 and illustrated in Appendix B.

Table 32. (U) NATO OSI Standards

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OSI Layer	Service Definitions STANAG	Service Definitions Draft Published	Protocol Specifications STANAG	Protocol Specifications Draft Published
Reference Model	4250 Ed 1 4250 Ed 2 Prt 1	Apr 86 (Ratified) May 90 (Draft)[a]	-	-
1	4251	13 Jul 90	4261	6 Jul 90
2	4252	Jul 90	4262	Jul 90
3	4253	Jul 90	4263	Jul 90
4	4254	Jul 90	4264	Jul 90
5	4255	12 April 90	4265	12 April 90
6	4256	19 Jan 90	4266	19 Jan 90
	4258 (ASN.1)	15 Jan 90	4259 (ASN.1 BER)	19 Jan 90
7	4257(MMHS)[b]	16 Feb 90	4257(MMHS)[c]	16 Feb 90

[a]The May 1990 draft of STANAG 4250 is being circulated to the Nations for ratification.
[b]Multiple STANAGs are planned for Layer 7; STANAG 4257 will address MMHS.
[c]For Layer 7 there will be a single STANAG for each pair of related Application Layer Service Definitions and Protocol Specifications.

(U) STANAG 4250, *NATO Reference Model for Open Systems Interconnection,* is being revised and the new draft developed in the May 1990 TSGCEE SG9 plenary meeting is being circulated to the Nations. The new STANAG will be in five parts, only the first of which is ready for ratification. The first four parts conform to the current structure of the OSI Basic Reference Model, ISO 7498.

- Part 1--*General Description*
- Part 2--*Security*
- Part 3--*Naming and Addressing*
- Part 4--*Management*
- Part 5--*Military Features.*

Two additional parts (*NATO Functional Profile Guidelines* and *Conformance Testing*) were separated from STANAG 4250 and will be drafted and ratified separately. In May 1990, SG9 agreed to reissue Edition 2 of STANAG 4250 as described above without going through a formal ratification process [Ref. 256]. Thus, STANAG 4250 has been forwarded to the TSGCEE for promulgation.

(U) During its meetings in February 1989, TSGCEE SG9 WG2 addressed the impact of the eight military features on the Session and Presentation Layers, especially for

security, quality of service, and multipeer data transmission. WG2 determined that for both the Session and Presentation Layers there are no military features that have been defined, that are needed in the near term, and that are not supported by the OSI standards. WG2 has therefore forwarded the draft STANAGs for the Session and Presentation Layer (STANAGs 4255, 4256, 4265, and 4266) and ASN.1 (STANAGs 4258 and 4259) to TSGCEE SG9 for ratification; TSGCEE SG9 decided in March 1989 to distribute these drafts to the nations to begin the ratification process. These drafts were modified by WG2 in February 1990 and provided to SG9 in May 1990. SG9 identified a number of editorial problems with the draft STANAGs, requested these be addressed by WG2, and asked for revised drafts at the December 1990 SG9 plenary meeting.

(U) The remaining paragraphs in this section summarize the scope of the current drafts of these STANAGs. The STANAGs are discussed layer by layer beginning with Layer 1, the Physical Layer. The discussion emphasizes the portions of the STANAGs addressing deficiencies and enhancements for the military features.

10.4.1 Physical Layer STANAGs

(U) Draft STANAG 4251 (July 1990) identifies for the Physical Layer all eight areas for potential military enhancements and summarizes the services provided by and the deficiencies of current civil standards. All but three of the areas are identified as "not envisioned to affect the Physical Layer." The three areas in which enhancements are expected are:

- Network/system management functions. ISO 9595 (*Management Information Service Definition*) is cited for relevance, but military enhancements to those standards are left for further study (the July 1990 draft cites several parts to ISO 9595 that were dropped by ISO in 1989 when DIS 9595-2 was adopted as ISO 9595).
- Security. ISO 9595-7 (*Management Information Service Definition--Part 7: Security Management Service Definition*) is cited for relevance, but military enhancements are left for further study, to be provided as Annex B.
- Robustness and quality of service. ISO 9595-6 (*Management Information Service Definition--Part 6: Performance Management Service Definition*) is cited for relevance, but military enhancements are left for further study.

(U) Draft STANAG 4261 (July 1990) also identifies for the Physical Layer all eight areas for military enhancements, summarizes the protocols provided by and the deficiencies of current civil standards, but leaves specific military enhancements for further study. All but three of the areas are identified as "not envisioned to affect the

Physical Layer." The three areas in which enhancements are expected are the same as for STANAG 4251:

- Network/system management functions. ISO 9596 (*Management Information Protocol Specification*) is cited for relevance, but military enhancements are left for further study in Annex H (the July 1990 draft cites several parts to ISO 9596 that were dropped in 1989 by ISO when DIS 9596-2 was adopted as ISO 9596). The following statements are cited in Annex H as military "enhancements to CCITT Physical Layer protocols":
  (1) Unbalanced and balanced interchange circuits for use on general telephone systems in the tactical, sustaining base, and long-haul environments monitoring circuit fault conditions shall do so as indicated in V.24.
  (2) Data interchange circuits in the tactical, sustaining base, and long-haul environments monitoring circuit fault conditions shall do so as indicated in X.24.
  (3) In the tactical and sustaining base environment, all unbalanced interchange circuits shall detect circuit failure and interpret a fault condition as a type 3 circuit on which the receiver or load provides a special indication as stated in V.10. This is to be implemented as a service provided by the Physical Layer management entity and sent to the fault management application entity as a system management data unit.
- Security. ISO 9595-7 (*Management Information Protocol Specification--Part 7: Security Management Protocol Specification*) is cited for relevance, but military enhancements are left for further study, to be provided as Annex B.
- Robustness and quality of service. ISO 9595-6 (*Management Information Protocol Specification-Part 6: Performance Management Protocol Specification*) is cited for relevance, but military enhancements are left for further study in Annex H.

(U) Requirements for Mechanical Aspects (Annex D) are provided by STANAG 4261 in the areas of connectors, pin outs, cabling, and shielding and dielectric. Requirements for Functional Aspects are provided for data and control (timing and grounds are left for further study). Requirements for Electrical Aspects are provided for interchange circuits and cabling. Requirements for Procedural Aspects are provided in connection establishment (connection completion, connection maintenance, and data transfer are left for further study). Requirements for fault management, configuration management, performance management, and security management are briefly discussed under Management Aspects. Annex I will address military requirements for the X.21 "permanent" protocol and Annex J will address the tactical "K" protocol.

10.4.2 Data Link Layer STANAGs

(U) STANAG 4252 will address, as does ISO 8886 upon which it is based, both CO and CL modes of service. None of the security aspects (Annex B) have

yet been identified for the Data Link Layer. STANAG 4252 identifies deficiencies only in one of the eight areas for enhancements:

- Network/system management. The definition of the Data Link Management Objects and their manipulation are not covered in the existing ISO standards, but are the subjects of on-going work and are expected to be completed in the near future. After completion it will be verified if military enhancements are requisite. Data Link Management Objects are required for DIS 10164, DIS 10165, and ISO 9595.

(U) The current draft STANAG 4262 indicates that "no need for enhancement was identified" for all but one of the eight areas of potential military features. The remaining area is addressed as follows, without specifying the protocols needing enhancement:

- Network/system management. Enhancements are needed, but these may be provided as a result of the on-going ISO standardization work. If this is not the case, further work would be needed to provide the missing military enhancements. Note: The specification of Data Link Layer Management Objects is the subject of the work item JTC 1.06.04 in ISO.

(U) Annex D of the current draft STANAG 4262 addresses the Balanced Link Access Procedure B (LAP B), based on ISO 7776 and provides for the CO-mode data link service used by packet level protocols (PLPs) such as CCITT X.25 PLP and ISO 8208. Annex E addresses LAP D based CCITT I.440 and I.441. Annex F addresses the Logical Link Control (LLC) and the Media Access Control (MAC) protocols, based on ISO 8802-2 (LLC), 8802-3 (CSMA/CD LAN), 8802-4 (Token Bus LAN), and 8802-5 (Token Ring LAN). The LLC, when used with the appropriate MAC data link sublayer protocol, provides CO and CL-oriented data link service in a LAN environment. Annex G addresses the data link protocol Balanced Class of Procedures (BAC) based on the HDLC standards ISO 7809, 4335, 3309, and 8885 and provides CO- and CL-mode services. Options explicitly include Exchange Identification (XID), UI frames for CL-mode data transfer, selective reject, extended sequence numbering, test, and extended frame check sequence capability (32-bit frame check sequence).

10.4.3 Network Layer STANAGs

(U) STANAG 4253 is based on ISO 8348 *(Network Service Definition)*, including the three addenda, and thus provides for both connection-mode and connectionless data transmission. The Security Annex is classified; as provided in the NOSA document (see Section 8.1.3.2), it addresses services such as peer entity authentication, data origin authentication, access control, connection confidentiality,

connectionless confidentiality, traffic flow confidentiality, connection integrity without recovery, and connectionless integrity. STANAG 4253 addresses the areas of deficiencies of the civil standards shown in Table 33 for providing military feature enhancements.

Table 33. (U) Areas of Deficiencies for STANAG 4253

UNCLASSIFIED

(1)	Multihoming. In the interest of survivability, an end system, identified by a single "logical" network address, may need to be connected at several Subnetwork Points of Attachment (SNPAs) either with more than one link into the same subnetwork or with links into several subnetworks. Routing management functions will be needed in order to determine the SNPA to be used; enhancements for routing management (if any) are for further study.
(2)	Mobile Hosts. This requirement is for end systems identified by a single logical address to be able to connect to different SNPAs, although only one connection may be in use at any one time. In this case it may not be possible to determine in advance which subnetwork links will be involved in establishing connections associated with a particular subscriber address. The Network Layer addressing is extended in this STANAG to support logical network addresses that may identify more than one NSAP. Enhancements for routing management (if any) are for further study.
(3)	Multiaddressing. To economize on network bandwidth and increase speed of delivery, an application that involves sending the same data to a number of destinations will require a multi-addressing service (multipeer data transmission) within the Network Layer, which provides either selective addressing or broadcast facilities. The Network Layer addressing is extended in this STANAG to support multicast addresses that may identify more than one NSAP. Enhancements for multipeer data transmission are for further study.
(4)	Management. Additional management facilities may be required to support the other military enhancements. Military enhancements of the ISO Network Layer management objects are for further study.
(5)	Security. The ability is required to signal the security label of each network connection and each connectionless service data unit. The security classification will remain constant throughout the life of a connection. The security label for a network connection or a connectionless service data unit may be signalled as a protection QoS parameter.
(6)	Robustness. The ability to survive physical damage and denial of service attacks and to route around damaged or partitioned networks is required for military systems. Military enhancements to Network Layer management functions for robustness are for further study.
(7)	Precedence and Preemption. No requirement for military enhancement has been identified beyond the priority QoS parameter defined in ISO 8348.
(8)	Real-Time Communications. Enhancements for real-time communications are for further study.

Source: *Draft STANAG 4253*, July 1990, NATO UNCLASSIFIED.

(U) Annex D to STANAG 4253 discusses the two types of addresses used in the Network Layer: (1) subnetwork addresses, which identify a point of attachment to a subnetwork (e.g., an X.25 network) and (2) network address, which is (ISO 7498-3) a name, unambiguous within the OSI environment, that is used to identify a set of NSAPs. An NSAP-address is a network address that is used to identify a single NSAP. The subnetwork address must be derivable from the network address, either directly using a field of the network address or indirectly using table lookup/directory service functions. An NSAP may have two or more NSAP-addresses, such as where a

system performs two roles (e.g., National and NATO) or where a system is multihomed. Annex D provides technical detail on:

- Addressing schemes, including the Initial Domain Part (IDP) and the Domain Specific Part (DSP) of an NSAP-address, the Authority and Format Identifier (AFI) and Initial Domain Identifier (IDI) that make up the IDP, and the four basic schemes recognized by ISO 8348/AD2.
  (1) CCITT numbering schemes for public networks--the IDI is X.121 for packet switched networks, F.69 for Telex, E.163 for circuit switched networks, or E.165 for ISDNs.
  (2) Schemes with an address allocated under a national registration authority, in which the IDI is an ISO Data Country Code (DCC) according to ISO 3166.
  (3) Schemes with an address allocated under an international registration authority, in which the IDI is an ISO International Code Designator (ICD) allocated according to ISO 6523.
  (4) Local schemes that would only be recognizable amongst a restricted network of systems.
- The NATO-ICD scheme, in which NATO, as an international authority, allocates addresses. The AFI is 46 for ICD decimal addresses and 47 for binary addresses. Currently there is one NATO addressing sub-schema defined, the scheme "X" that uses AFI=46 and NATO Format Identifier=10. This scheme is for use with decimal coded addresses using NATO domain identifiers allocated under STANAG 4214.
- Multicast addressing, which can be used in the Network Layer to identify a set of NSAPs. Multicast addresses are defined as extensions to the network addressing scheme and so can operate only between NSAPs supporting the same scheme. Multicast addressing across national boundaries is not supported by the DCC scheme.

(U) STANAG 4263 provides for three types of CO-mode Network Layer protocols: (1) DTE-to-DTE, based on the 2nd Edition of ISO 8208 (*X.25 Packet Level Protocol for DTE,* 1990); (2) DTE-to-DCE, based on ISO 8878 (*Use of X.25 to Provide the OSI CO Network Service*) and the 2nd Edition of ISO 8208 for end systems and on CCITT X.25(1988), Sections 3, 4, 5, 6, 7, and Annexes A-I, for subnetworks; and (3) STE-STE, based on the X.75 Packet Level Protocol (Sections 3 through 5 and Annexes A through E) for the interconnection of two packet-switched data networks. These all provide the connection-oriented network service (CONS). The use of the X.25 PLP to provide the CONS over an ISO 8802 LAN is not currently addressed in STANAG 4263.

(U) Annex B on security for STANAG 4263 has yet to be produced (as of July 1990), but will address--as provided in the NOSA document (see Section 8.1.3.2)--services such as peer entity authentication, data origin authentication,

access control, connection confidentiality, connectionless confidentiality, traffic flow confidentiality, connection integrity without recovery, and connectionless integrity.

(U) No military enhancements are specified in STANAG 4263 Annex D for the DTE-DTE CONS. The required military enhancements for DTE-DCE CONS (Annex C) are given in Table 34.

Table 34. (U) Military Enhancements Identified for Annex C of STANAG 4263

UNCLASSIFIED

(1)	Security. The use of the network service Protection Quality of Service parameter to associate a security level with a network connection is for further study.
(2)	Precedence and preemption. The priority of a network connection shall be indicated, when appropriate, by means of the network service Priority Quality of Service parameter. This parameter is mapped in this protocol to the Priority CCITT-specified DTE facility as defined in ISO 8878 DAD1. The use of this facility is optional in this STANAG, but may be enforced by specific profiles. Absence of the Priority facility from any of the packet types in which it may appear shall be interpreted as indicating the lowest defined priority level, and Priority-aware implementations shall act accordingly. The Priority facility shall be transmitted unchanged between the two network service users; however, this STANAG extends the specification of X.25(1988) in the following way: a subnetwork may inspect the Priority facility in order to record the priority of a connection and may use this information to preempt a lower priority connection under certain (subnetwork-dependent) conditions. In this case, the subnetwork shall clear the connection, with cause "DCE originated" and reason "QoS not available--transient condition," with the result that both network service users receive an N-Disconnect indication with originator "NS provider" and reason "Connection rejection--QoS not available/transient condition." Priority values are integers in the range 0 to 14, with 255 meaning "unspecified."
(3)	Multihoming. Multihoming may be achieved through the X.25 Hunt Group optional user facility, provided the SNPAs corresponding to the various "homes" can be defined as members of an X.25(1988) Hunt Group. The use of the Hunt Group facility for multihoming is transparent to the OSI network service user. Three types of Network Layer management facilities are specified in the STANAG to support the use of a Hunt Group: configuration, multihoming subscription options, and multihoming registration.

Source: *Draft STANAG 4263*, July 1990, NATO UNCLASSIFIED.

(U) An enhancement for only one military feature is specified in Annex E for interconnecting two packet-switched networks using X.75:

- Precedence and preemption. The priority of a network service connection shall be indicated, when appropriate, by means of the network service Priority Quality of Service parameter as in Annex C. This parameter is mapped by the protocol to the X.25(1988) Priority facility. According to X.75(1988), the Priority facility is relayed unchanged as an X.25 user facility, which may be inspected and whose values are stored, but which does not affect the progress of the virtual call. This STANAG extends the specification of X.75(1988) in the following way: an STE may record the priority of a call and use this value to preempt a lower priority call under certain (implementation-dependent) conditions. In this case, the STE shall clear the call with cause "DCE originated" and reason "QoS not available--transient condition," as though the

call had been cleared by one of the interconnected subnetworks according to the specifications of Annex C. Priority values are integers in the range 0 to 14, with 255 meaning "unspecified."

(U) Annex E to STANAG 4263 defines an internet protocol (IP) for CL-mode network service and relies on the provision of an underlying CL-mode service directly from a CL-mode real subnetwork or indirectly through the operation of an appropriate Subnetwork-Dependent Convergence Function (SNDCF) or Protocol (SNDCP) over a CO-mode real subnetwork. Annex E is based on ISO 8473 (Sections 3-9 and Annexes A-C) and provides extensions for the following three military features:

- Security. A security parameter is provided in every IP Protocol Data Unit (PDU) using the Security Option. The structure of this parameter is for further study.
- Precedence and preemption. Priority is realized through selection of a parameter in the options part of the PDU header. The priority option shall be mandatory for end systems and intermediate systems conforming to this standard. Encoding of the precedence and preemption parameter and the error conditions are specified in the STANAG.
- Multicasting. It is necessary to allocate and reserve address space for multicasting and broadcasting in IP; extensions to IP to implement and manage multicasting are still to be defined.[42] Concepts for multicast addresses are described in detail in the STANAG.

10.4.4 Transport Layer STANAGs

(U) STANAG 4254 provides the transport service definition. Since NOSA (see Section 8.1.3.2) identifies no security services for the Transport Layer, there are no military-specific security services or protocol enhancements. The CO transport service (Annex C) is based on ISO 8072. The CL transport service (Annex D) is based on ISO 8072/AD1 (with the restriction that the note of paragraph 15.2.3 is not retained).

(U) Annex E of STANAG 4254, *Real-Time Transport Service (RTTS)*, has been proposed as fulfilling the real-time military features for NATO military systems. Specifically, RTTS is designed to offer more functionality to such services as connection service and data transfer service and to provide additional services such as synchronization and management. RTTS provides services for broadcasting, selective broadcasting, and concentration. Chapter 2 of Annex E, *Definition of the Real-Time Transport Service (RTTS) Provided by the Transport Layer*, uses concepts, terminology,

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[42] (U) Draft STANAG 4263 identifies US DoD RFC 1054, *Host Extensions for IP (DoD) Multicasting*, as the source for descriptions of the required extensions to ISO IP. See Appendix H.

and structure similar to ISO 8072 for transport Classes 0, 1, and 2. RTTS appears to impact more than a single layer (Layer 4) and does not appear to fully conform to the Basic Reference Model ISO 7498.

(U) Deficiencies and required enhancements in seven areas are noted in STANAG 4254 for both CO-mode and CL-mode transport services as shown in Table 35 (internetworking is not applicable).

Table 35. (U) Deficiencies and Enhancements Identified for STANAG 4254

UNCLASSIFIED

(1)	Multihomed and mobile host systems. No requirement as the transport service is not affected by either the multiple attachment of a host to two or more nodes or subnetworks nor the change at any time by a host of network or subnetwork attachment.
(2)	Multiaddressing. The transport service does not provide any service or function related to multiaddressing. To specify the addresses of participants in a multipeer connection, the Group Address can be resolved into a number of ordinary addresses or the address parameters in the service definition can be redefined to permit the use of a list of addresses rather than just one.
(3)	Network/system management functions. Transport management service primitives are required to satisfy this requirement, and the primitives defined in ISO 9595 (CMIS) are satisfactory for the communication of information related to the Transport Layer managed objects. Specific management objects and functions need to be defined.
(4)	Security. According to the NOSA, no security services are specified for the Transport Layer and no security enhancements are required.
(5)	Robustness and Quality of Service (QoS). No enhancements required. QoS parameters are provided for data transfer service enabling the user to control and check the QoS. These parameters are negotiated during the connection establishment phase.
(6)	Precedence and preemption. No enhancements required. A QoS parameter is provided to express the priority of a transport connection. This parameter is negotiated during the connection establishment phase.
(7)	Real-time and tactical communications. In real-time communications, the requirement to have short transit delay for the transfer of data is more important than the requirement to have data delivered without sequence errors. There is also a requirement for such services as sampling process data transmission, periodic data transmission, and synchronization service, which are not provided by the ISO transport service. For real-time communications, the definition of services is for further study. For tactical communications, ISO transport services are suitable.

Source: *Draft STANAG 4254*, July 1990, NATO UNCLASSIFIED.

(U) STANAG 4264 provides the transport protocol specification. The connection-oriented transport protocol (Annex C) is based on ISO 8073. End systems must implement transport protocol Classes 0 and 2; other classes may be implemented in addition. The deficiencies and enhancements to seven of the military features (internetworking does not apply) are given in Table 36.

Table 36. (U) Deficiencies and Enhancements Identified for Annex C of STANAG 4264

UNCLASSIFIED

(1)	Multihomed and mobile host systems. The protocol shall have the recovery mechanism of Classes 1, 3, or 4 in the case where the Network Service Provider releases the network connection each time the host system changes SNPA and the QoS requirement specifies low probability of unexpected connection release. If the classes 0 or 2 are used, the recovery of the connection shall be provided either in the Network Layer or in the Application Layer.
(2)	Multiaddressing. Savings in time and bandwidth can only be achieved if mechanisms are introduced into layers that inherently possess the ability to support communications to multiple destinations simultaneously (Layers 2 and 3).
(3)	Network/system management. Specific military managed objects for the Transport Layer will be specified when they are identified. They will be specified as extensions/modifications to the civilian managed objects.
(4)	Security. There are no specific security functions and no required enhancements.
(5)	Robustness and Quality of Service (QoS). Transport Layer specifications of the mechanisms needed to respect the QoS requirements are for further study.
(6)	Precedence and preemption. Transport Layer specifications of the mechanisms involved by the management of the priority are for further study.
(7)	Real-time and tactical communications. To be defined.

Source: *Draft STANAG 4264*, July 1990, NATO UNCLASSIFIED.

(U) Annex D specifies the connectionless transport protocol, based on ISO 8602. Enhancements are the same as in Annex C with the following exception:

- Multihomed and Mobile Host Systems. Since no data acknowledgement is provided by the service, the protocol is not affected when a remote host system changes its SNPA and is not reachable temporarily.

(U) Annex E specifies the connection-mode transport protocol over CONS, based on ISO 8073 and ISO 8073/AD2 (*Class Four Operation Over Connectionless Network Service*) using TP4. Enhancements are the same as in Annex C with the following exceptions:

- Multihomed and Mobile Host Systems. Since no network connection is released when a remote host system changes its SNPA and since TP4 offers error detection and recovery mechanisms, this protocol is not affected by this military feature.

(U) Annex F of STANAG 4264, *Real-Time Transfer Protocol Over Connectionless Network Service*, is still to be defined.

10.4.5 Session Layer STANAGs

(U) The two Session Layer STANAGs (4255 and 4265) have been developed by WG2 with the US serving as editor. Both these STANAGs have been recommended by WG2 to be distributed by SG9 for ratification without military features.

(U) STANAG 4255 is based on ISO 8326, *Basic Connection-Oriented Session Service Definition.* Annex D is reserved for connectionless session services. The only military deficiency areas identified in the draft STANAG are for security and multi-endpoint connection:

- Security. A mechanism for providing graceful closure may be required by NATO in the long term. At present, this requirement is insufficiently refined to allow a service realization. Therefore, no enhancement of ISO security measures can be provided at this time
- Multi-endpoint connection. ISO is currently considering multipeer data transmission requirements for the Session Layer. This activity will be monitored by the developer of this STANAG, and this paragraph will be updated as developments warrant. An enhancement requirement is contingent upon ongoing developments within ISO.

(U) STANAG 4265 is based on ISO 8327, *Basic Connection-Oriented Session Protocol Specification.* An annex (Annex D) is reserved for information regarding the Connectionless Session Protocol Specification. The deficiencies and enhancements for STANAG 4265 are the same as for STANAG 4255.

10.4.6 Presentation Layer STANAGs

(U) The two Presentation Layer STANAGs (4256 and 4266) have been developed by WG2. In addition, STANAGs have been drafted for ASN.1 (STANAG 4258) and the Basic Encoding Rules for ASN.1 (STANAG 4259). All four Layer 6 STANAGs have been recommended by WG2 to be distributed by SG9 for ratification without military features.

(U) STANAG 4256 will initially be based on ISO 8822, *Connection-Oriented Presentation Service Definition.* An annex (Annex D) is reserved for connectionless presentation services. Potential deficiencies have been noted in three areas:

- Security (Annex B). NOSA has placed additional security-related services in the Presentation Layer, but these are not yet defined in detail. Modifications are anticipated in the ISO standards following ISO 7498-2, which may meet the emerging military requirements. No security enhancement to the ISO Presentation Layer is currently available. However, as solutions are available this STANAG will be amended.
- Mobile hosts and multihomed systems. No deficiencies noted (subject to change dependent upon the ability of the lower layers to support this feature).
- Multi-endpoint connection. Modifications will be needed to the Presentation Layer if multi-endpoint connections are required in an implementation, but no specific requirements have yet been identified. Modifications will be made to

the ISO standard once the multipeer data transmission work in ISO has been progressed.

(U) STANAG 4266 is based on ISO 8823, *Connection-Oriented Presentation Protocol Specification*. Annex D is reserved for the connectionless presentation protocol specification. The military deficiencies and enhancements for STANAG 4266 are the same as for STANAG 4256.

(U) Separate NATO agreements will address ASN.1 (STANAG 4258) and the ASN.1 basic encoding rules (STANAG 4259). These are based on ISO 8824 and ISO 8825. No deficiencies were found in these based standards and no enhancements are recommended.

(U) STANAG 4259 observes that additional sets of encoding rules for ASN.1 may be required for specific applications giving either compressed (minimum volume) or encrypted encodings. No specific requirements in this area have yet been identified. Following work in these areas by ISO, additional ASN.1 encoding rule STANAGs may be developed. A remark provided at the end of STANAG 4258 observes that ISO 8824/1 includes a note that makes reference to the encodings for the Real Type by the *Basic Encoding Rules for ASN.1* (ISO 8825)--this note is not relevant if alternative encoding rules are to be employed.

10.4.7 Application Layer STANAGs

(U) The only Application Layer STANAG that has been produced in draft form is the draft MMHS STANAG 4257. The status of the MMHS work is discussed in Section 10.3.8. An initial focus meeting on FTAM was planned for June 1990 (see Section 10.3.3.4).

(U) The February 1990 draft MMHS STANAG identifies the STANAG as the Military Base Standard. The draft states that other STANAGs will define related MMHS profiles that will define additional requirements related to particular environments, but the May 1990 report of WG2 to SG9 states that the profiles will be included as separately ratifiable annexes to STANAG 4257. The draft STANAG has four annexes:

- Annex A, *Scenarios and Rationale*, provides detailed specification of the scenario of application and rationales behind the major decisions. It also discusses support of the subset of the eight military features that are applicable to a store-and-forward messaging environment.

- Annex B, *Military Message Handling System Extensions*, provides the set of extensions to civilian MHSs for Interpersonal Message Service required for military messaging.
- Annex C, *Security Aspects of MMHS*, identifies the service, protocol, and operational requirements related to security. This annex would be classified NATO SECRET.
- Annex D, *Gateway Translations*, provides detailed specification of the interface between MMHS and other messaging systems, including ACP systems [e.g., ACP 121 *(Communications Instructions-General)*, ACP 126 *(Communication Instructions--Teletypewriter/Teleprinter Procedures)*, and ACP 127 *(Communication Instructions--Tape Relay Procedures)*].

(U) Table 37 identifies the military features as they affect MMHS.

10.5 Development of Other Technical STANAGs

(U) This section will identify non-OSI STANAGs that appear to be relevant to ATCCIS technical standards. Media-dependent STANAGs (e.g., on tactical data links) are not addressed.

10.5.1 Network Independent Interface (NIIF)

(U) NIAG SG6 is developing a draft specification of a Network Independent Interface (NIIF). This was briefed to the TSGCEE SG9 AHWG-OM in February 1989. NIIF is a concept for a combat system data distribution interface that could be used by the NATO Frigate Replacement for the 1990s (NFR90), a programme currently in a project definition phase.

Table 37. (U) Status of X.400(MHS)-1988 Relative to the Eight Military Features

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(1) Multihomed/Mobile Host

(a) Multihoming applies to MMHS applications in two ways: multihoming UAs and multihoming MTAs. In the first case, the MHS must allow a single user to have more than one Originator/Recipient (O/R) name. The second case requires MTAs that answer to more than one name. In both cases, the capability in question is outside the scope of the communications standards, but is permitted as an implementation option. Capabilities for multihoming would have no direct impact on either MHS services or protocols, but are instead more focused on the lower layers.

(b) Similarly, mobile hosting can also be applied to either the MTA or UA. In either case, the key requirement to support mobile hosting is the capability for the functional object in question to disconnect from the network for a period of time without serious consequence. In MMHS there are two mechanisms to support mobile hosting of the UA. One such mechanism is the use of a message store (MS) to act on the UA's behalf while the UA is off line. The second mechanism is use of the Hold for Delivery element of service, in which the service element instructs the MTS to defer delivery of a UA's messages until a later time. No such mechanisms are available to the MTA, however.

(2) Multipeer Data Transmission (MPDT)

Since MHS applications are store and forward (i.e., connectionless) in nature, no end-to-end connections are provided or required by MMHS. However, the MMHS does provide a connectionless MPDT capability in the form of multi-addressed messages. This feature allows a single message to be sent to several recipients with a single submission to the MTS. The MTS is then responsible for performing traffic splitting at the appropriate time. Note that traffic splitting could be substantially more efficient if supported by a lower layer MPDT function.

(3) Internetworking

Internetworking is addressed by the provision of MMHS/ACP 127 and MMHS/civilian gateway definitions. Gateways could also be created to other systems that perform similar message handling functions, but such gateways are at present beyond the scope of MMHS.

(4) Network and System Management

Network management is a pan-layer issue that falls under the auspices of the AHWG-OM in SG9. The AHWG-MMHS will continue to identify MHS-related topics to be considered by AHWG-OM.

(5) Security

Security is a pan-layer issue that falls under the auspices of the AHWG on Security in SG9. The AHWG-MMHS will continue to identify MHS-related topics to be considered by the Security AHWG.

(6) Robustness and Quality of Service (QoS)

Most aspects normally associated with robustness and QoS have no meaning in the Application Layer. Three MHS characteristics have been identified as significant in terms of robustness and QoS: loss of messages, end-to-end delivery time requirements, and selection of security services. QoS aspects relating to link quality, hop-by-hop transmission delay, and throughput are primarily lower layer issues, and in any case have little meaning for a store-and-forward Application Layer process.

(a) Loss of message is addressed by the MMHS expansion of X.400's redirection capability. This provides a dead letter box at each MTA so that messages will always be delivered rather than discarded. MMHS also provides both delivery and nondelivery receipt capability to provide additional assurance of delivery.

(b) MMHS has specified end-to-end delivery time requirements consistent with those used by ACP 127. The hop-by-hop transmission delay and throughput necessary to achieve those end-to-end times are lower layer issues.

(c) Selection of appropriate security services is largely dependent on the security policy in force. This policy will determine what services will be enabled during the origination of a message based on its classification or other factors. This selection could be done either technically or procedurally, however, and thus is purely an implementation issue. Whatever solution is used will impact only the originator and will not require changes to the communication protocols.

Table 37. (U) (Continued)

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(7)	Precedence and Preemption The established requirement for military priority in message handling is four levels based on ACP 127. The MMHS base standard provides six priority levels in all protocols necessary to support the use of precedence and preemption in any implementation. However, it is the intent of the AHWG-MMHS to develop functional profiles that support six levels of priority in the UA-to-UA protocols but only three levels in the corresponding MTA-to-MTA protocols. Use of these provided information elements to support precedence and preemption in either the UA or MTA is an implementation issue.
(8)	Tactical and Real-Time Communications MMHS has specified end-to-end delivery time requirements that are purported to represent the tactical environment. In addition, the AHWG-MMHS plans the development of a *Beta Profile* tailored to low bandwidth tactical applications.

Source: *Draft STANAG on Military Message Handling System*, 16 February 1990, NATO UNCLASSIFIED.

(U) In a subsequent joint meeting with the NIAG SG6 and TSGCEE SG9 WG1 in June 1989 [Ref. 278], the NIIF was identified as a project to (1) put NACISA in the lead to resolve interface problems and provide management structure for such projects; (2) provide near- and mid-term standards specification for ACCIS interoperability; (3) initially develop interface specifications to pass character-oriented messages between existing systems; and (4) evolve the specification so that it will be suitable for other services (e.g., file transfer, virtual terminal). The specifications were to be based on ISO OSI standards and on functional profiles of SPAG and CEN/CENELEC that are adopted in the *NTIS Transition Strategy*: T.21 Permanent Circuit (telephonic), T.22 Switched Circuit (telephonic), and T.31 Permanent Access to a PSDN. BID-1000 and KG-84 were identified for communications security. The message handling area was based on A/3211 from the EWOS.

(U) As early as September 1987, NIAG SG6 proposed a draft STANAG for *NATO Naval Intra-Ship Tactical Control and Data Handling Open Systems Interconnection, Network Independent Interface, Transport Service Definition for Connection-Mode Transmission* [Ref. 279]. This proposal was based on ISO 8072 with "additions and deletions, where necessary, to reflect a unique Naval, intra-ship, interpretation to it." The NIIF is identified in this proposal as a collection of standards that provide the complete definition of an interface between the User and the Data Transfer System, based on unique requirements for real-time, fault tolerant information exchange between peer systems. Reference 280 provides a statement of the programme of work planned by NIAG SG6 for 1990-1992.

10.5.2 Lightweight Protocols

(U) The TSGCEE AHWG on Restructuring has noted that the work of NIAG SG6 is closely related to the work of TSGCEE SG9 on OSI standards. Both groups are interested in the area of lightweight LAN profiles for multi-Service use. The basis for the intraship LAN profile being developed by NIAG SG6 is based on France's GAM-T-103, as is the US SAFENET profile and the more general Express Transfer Protocol (XTP) profiles [Ref. 281].

(U) The Xpress Transfer Protocol (XTP) is a lightweight (providing simplicity and low overhead) transfer protocol with unified internetwork services associated with OSI Layers 3 and 4. XTP conforms to the architecture of the Transfer Layer in RTTS developed in France for use in LANs (see Section 10.4.4) [Ref. 282]. XTP is designed to support 100 Mbps sustained transfer rates between application programs with growth to 1 Gbps. XTP is designed to provide services for distributed systems not available in ISO TP4 and US DoD TCP; the requirements include supporting remote procedure calls and rapid request/response operations, coordinating multiple processes, and providing transaction-based file access. XTP supports traditional stream services, bulk transport, real-time reliable datagram service, real-time internet gateways, flow/error/rate control, message delivery confirmation, selective retransmission, message boundary preservation, multiple addressing plans, out-of-band signalling, reliable multicast mechanism, maintenance packets, and multipath capability [Refs. 283, 284].

(U) XTP has been submitted to ANSI X3.S3 for standardization of its services. Its standardization is also being progressed in the US Navy SAFENET Committee.

10.5.3 EUROCOM and US/EUROCOM

10.5.3.1 EUROCOM. (U) EUROCOM is a technical working group composed of representatives from the NATO European nations whose aim is to achieve better coordination and interoperability in tactical communications systems between European Allied armies. EUROCOM is a subgroup of the EUROGROUP, an informal grouping of European governments within the framework of NATO. Rather than trying to agree on a single system, it is EUROCOM's plan to introduce communications systems in accordance with agreed operational requirements and basic system parameters in such a way that there is complete interoperability among systems built to EUROCOM standards. EUROCOM standards are frequently offered as the basis for NATO STANAGs on tactical communications [Ref. 285].

(U) The documents (D) currently promulgated by EUROCOM include:

- EUROCOM D/0: *System Concept*, CONFIDENTIAL (date of last revision unknown)
- EUROCOM D/1: *Tactical Communications Systems Basic Parameters*, 1986 (Revised September 1988), RESTRICTED
- EUROCOM D/2: (title and date unknown) subject is testing.

10.5.3.2 US/EUROCOM (U) US/EUROCOM is an informal tactical communications technical working group comprising the EUROCOM nations and the United States, Canada, and France. The purpose of US/EUROCOM is to work toward better and less cumbersome interface arrangements, to monitor the implementation agreements on communications characteristics, and to promote cooperation in the procurement of equipment conforming to these characteristics. Much of the preliminary technical work leading to ratified standardization agreements is accomplished by this group.

(U) With respect to work in OSI, the principal interest in US/EUROCOM is with the lower three layers. Currently, US/EUROCOM is in the process of modifying STANAG 4249, *The NATO Multi-Channel Tactical Digital Gateway--Data Transmission Standards (Packet Switching Service)*, to reflect the 1988 version of CCITT Recommendation X.75. US/EUROCOM is also investigating the application of the protocol implementation conformance statement (PICS)-type proformas to the NATO multi-channel tactical digital gateway STANAGs [Ref. 285].

(U) On many occasions US/EUROCOM has accepted invitations from TSGCEE to work on the NATO STANAGs for tactical communications (not just gateways) and interoperability issues. US/EUROCOM has made major contributions to STANAGs 4206-4211 and 4350. Both EUROCOM and US military standards are being considered for drafts of STANAG 4290, *Fiber Optics*. In each case the technical recommendations from US/EUROCOM are provided to TSGCEE SG11 WG1 for further work, coordination, and distribution as draft STANAGs.

(U) The work of US/EUROCOM in developing a profile for a tactical gateway for packet switching (STANAG 4249) was briefed the TSGCEE SG9 WG1 in the October 1989 meetings in Brussels. In addition, Norway provided a paper[43] that suggested US/EUROCOM could undertake several tasks of interest to SG9. These include proposing protocol implementation conformance statement (PICS) proformas for the

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[43] (U) *US/EUROCOM's Role in Developing Profiles for NATO*, AC302/SG9/WG1-8910/15(NO), 2 October 1989, NATO UNCLASSIFIED.

STANAG 4206-4214 series (and possibly others, such as STANAGs 4290 and 5040); proposing tactical parts of the STANAG 4250 series; identifying profiles required by the tactical communities in NATO; and proposing NATO functional profiles for tactical applications. However, US/EUROCOM's role in developing profiles for NATO is still under consideration and has not been fully accepted by US/EUROCOM.

10.5.4 Other Efforts

(U) STANAG 4214, *International Routing and Directory for Tactical Communications*, may be applicable to ATCCIS technical standards; this standard is the responsibility of TSGCEE SG11. TSGCEE SG9 WG1 is looking at naming and addressing requirements and the applicability of STANAG 4214. STANAG 4249, *The NATO Multichannel Tactical Digital Gateway--Data Transmission Standards (Packet Switching Service)*, also the responsibility of SG11, addresses packet switching using a form of CCITT X.25; as such, this STANAG may also be applicable to ATCCIS technical standards. The Eurogroup on Cooperation of Tactical Communications Systems (EUROCOM) is reported to be preparing a revised draft for STANAG 4249 based on CCITT X.25 and the draft TSGCEE SG9 Functional Profile Guidelines document; such a draft would be submitted to SG11 as a contribution and developed into a STANAG.

10.6 Findings

(U) TSGCEE has identified and assessed eight military features that need to be incorporated in civil OSI standards, but little detail has yet been released (e.g., in drafts of STANAGs 4251-4266) to show how these features can actually be addressed in military versions of OSI standards. TSGCEE SG9 has an ambitious 18-month plan for progressing the NATO OSI data communications standards, but there is a need to reassess and revalidate the military features--clearly the deficiencies of 1990 civil standards are different from those identified in 1983. TSGCEE SG9 has been successful in many areas (such as security and OSI management) for introducing military work into the civil standards bodies and affecting the capabilities of the civil standards. One of the new approaches being taken by SG9 is the development of functional profiles, which individually address specific military scenarios and groups of requirements and are essential to ensure interoperability of implementations by the Nations; this work needs to be supported and expanded. Finally, there is also a need to identify additional resources and possibly new approaches to expedite the completion of these STANAGs.

11. NEAR-TERM APPROACHES FOR ACHIEVING INTEROPERABILITY IN NATO

(U) Existing and emerging ACCISs are designed to provide command and control information support for NATO and national systems. The ACE ACCIS will provide the higher-echelon support (i.e., at echelons above corps) for the military forces operating in the European region of NATO. ATCCIS will provide support for land combat tactical units, and the Air Command and Control System (ACCS) will support the air operations. The NATO Maritime Operational Intelligence Support (NMOS) and the Battlefield Information Collection and Exploitation System (BICES) will provide intelligence support. Other ACE ACCIS-related projects include the Standard Automated Message Interface for NATO's ACCISs (STAMINA), JRMS, the Status Control Alerting and Reporting System II (SCARS II), and the Nuclear Planning System (NPS).[44]

(U) This chapter begins by reviewing the standards associated with the *NATO C3 Master Plan and Architecture* (Section 11.1). It further examines the standards specified by near-term NATO and multilateral interoperability demonstration and development efforts in addition to ATCCIS, namely the ACE ACCIS (Section 11.2), ACCS (Section 11.3), BICES (Section 11.4), NMOS (Section 11.5), the Quadrilateral Interoperability Program (Section 11.6), and STAMINA (Section 11.7). Military features required by NATO are addressed. In addition, this chapter addresses some of the issues associated with evolving from near-term systems to ATCCIS through the use of standards. Profiles of standards that are to be used in transition implementations for several NATO projects are also presented.[45]

(U) The objective of this review is to ensure that the methodology used for the ATCCIS effort is comprehensive and that no classes of relevant standards have been overlooked. Some national initiatives to adopt and extend OSI standards for tactical employment are reviewed in Appendix C.

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44 (U) ACCS, ATCCIS, BICES, JRMS, NMOS, NPS, and SCARS II are the seven ACE CCIS-related projects identified in the *ACE Inventory of Key Tasks*, December 1988, NATO CONFIDENTIAL.

45 (U) Profiles differ from stacks in that a profile usually consists of several stacks of standards and further that profiles are usually recommended for a certain transition strategy or a specific implementation. In some cases, profiles specify options to be used.

11.1 NATO C3 Master Plan and Architecture

(U) This section reviews the status of the *NATO Consultation, Command and Control (C3) Master Plan* and identifies its relationship to the assessment of standards for ATCCIS. The Master Plan consists of four documents: the Master Plan Overview [Ref. 286], *TRI-Major NATO Commanders' Command and Control (C2) Plan* [Ref. 287], *Political Consultation and NATO Civil Emergency Planning (PCNCEP) CIS Plan* [Ref. 288], *and the NATO C3 Architecture* [Ref. 289-293]. The *NATO C3 Architecture* consists of five volumes. The two most relevant to the ATCCIS Architecture are Volume 3, *Information System Subsystem,* and Volume 4, *Communications Subsystem.* Much of the material of Volume 3 was drawn from the ATCCIS architecture. The standards annex to Volume 3 is an early draft of WP 25.

(U) The *NATO C3 Master Plan* was formally considered at the January 1990 plenary of TSGCEE. TSGCEE prepared a statement, to be submitted in February 1990, to the Conference of National Armaments Directors (CNAD) that endorsed the *NATO C3 Master Plan* with the following caveats [Ref. 246]:

- The *NATO C3 Master Plan* presents a significant first step towards development of a sound investment strategy for major improvements in NATO C3.
- However, the TSGCEE does not consider the *NATO C3 Architecture* to be sufficiently mature to warrant its endorsement as part of the overall Plan and requests that the CNAD invite the NACISC to decouple the *Consolidated Architecture* (Volume 1) when submitting the Plan for approval to the North Atlantic Council Defence Planning Committee.
- Nations agreed to pursue and resolve many minor issues in the appropriate forums.

11.2 ACE ACCIS

(U) The initial phase of development of a standardized and interoperable ACE ACCIS was the Architectural Design Study. The next phase is System Design and Integration, for which a major support contract has been awarded by the NATO Communications and Information Systems Agency (NACISA). Work on the System Design and Integration Contract (SD&IC) began in early 1989 and is expected to be completed in 1991.

(U) ACE ACCIS will provide automation support for NATO headquarters at echelons above corps (e.g., PSCs). The SD&IC will provide about 450 person-months of effort from January 1989 to April 1991. Among the SD&IC objectives are the ACE-wide

issues of interoperability and standards, and the contractor will be identifying the functions to be supported at each interface. NACISA intends to ensure that the project complies with NATO standards and the *NTIS Transition Strategy*. STAMINA has been mandated for the SD&IC effort. The planned products include [Ref. 294]:

- Logical models of the existing system and a new system
- Generic description of the new system, together with a complete functional design that "embodies technical standards"
- Recommended implementation options and transition plan
- Procurement specifications to support procurements in the Central Region and the Southern Region in the 1990s
- Automated support for configuration management.

NACISA expects that the products of the SD&IC effort will become standards for NATO.

11.3 Air Command and Control System (ACCS)

(U) The Air Command and Control System (ACCS) is a system to support air operations planning, tasking, and execution throughout ACE from Major NATO Command (MNC) level to combat unit level.[46] ACCS will interface with the ACE ACCIS at the Primary Subordinate Command (PSC) and will concentrate new development at the PSC and below. ACCS will progressively replace a current federation of individual systems that support ACCS functions to varying degrees.[47] At the PSC level and above, ACCS functions will be performed by the ACCIS of each Command.

(U) Development of ACCS, which integrates offensive and defensive air command and control functions, has been underway for several years. Implementation is planned to begin in the early 1990s. In April 1989, the ACCS team completed the *ACCS Master Plan*. The ACCS team was replaced by the ACCS Interim Management Agency, and the new group will conduct a system definition phase. The goal is preparation of system specifications and technical estimates for a Type B cost specification for and procurement by Slice 42 (1991).

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46 (U) The seven ACCS major functional areas are: Force Management (FM), C2 Resource Management (C2RM), Airspace Management (AM), Surveillance (S), Air Mission Control (AMC), Air Traffic Control (ATC), and Information Exchange.

47 (U) The systems include Improved United Kingdom Air Defense Ground Environment (IUKADGE), Systeme de Traitement et de Representation des Informations de Defense Aerienne (STRIDA), German Air Defense Ground Environment (GEADGE), and NATO Airborne Early Warning (NAEW).

(U) The interoperability concept for ACCS is discussed in Volume IV, *Generic Portion of the Overall ACCS Design,* of the *ACCS Master Plan,* [Ref. 295], and in the *Supporting Document on Organization Components* [Ref. 296]. ACCS interoperability is planned through exchange of information through commonly agreed to information definitions, formats, and technical standards. Where possible, the standards to be used are those developed by the Military Agency for Standardization (MAS), ADSIA, and TSGCEE SG9. Specifically, ACCS will be based on the OSI Reference Model as specified in STANAG 4250 (NATO Interoperability Model), the OSI services for Layers 1 through 7 as specified in STANAGs 4251-4257, and the OSI protocols for Layers 1 through 7 as specified in STANAGs 4161-4267. In addition to the ISO Reference Model standards, the NATO Common Interface Standards will be used. TSGCEE SG9 is responsible for the OSI technical standards, and ADSIA is responsible for the procedural standards. Operational interoperability standards will be based, in part, on Allied Tactical Publications (ATPs). In addition, the CCITT ISDN network architecture is being evaluated for full integration of communication services in ACCS.

(U) The ACCS communications concept is to integrate the various NATO and national dedicated communications systems currently used to support air operations into a common user data and voice network. ACCS would be hosted on the existing and planned communications without ACCS-unique communications means. Initially a packet switched data communication overlay would be added to the circuit-switched voice system. This would evolve into common user area ISDNs within each NATO region. Continued support for both character-oriented and bit-oriented messages is required. Specifically, use of tactical data link standards such as Link 4, Link 6, Link 11, Interim JTIDS Message Standard (IJMS), and Link 16 would continue through the foreseeable future.

(U) ACCS has been reviewing technical information exchange standards and requirements, including the need to replace Link 1 for data exchange[48] in the ground environment. The current approach is to base a new standard on STANAG 5516 (J-Series messages) and to develop (within ADSIA WG4) new or modified messages to fulfill specific ACCS Information Exchange Requirements. ACCS plans to use a military version of X.25 for packet-switched systems and for transfer over dedicated circuits and through circuit switches. Variable packet lengths are desired. CSMA/CD and token ring LANs are being considered for ADP systems. As in ATCCIS, the ACCS database concept is partitioned and partially replicated (see Sections 2.1.3 and 6.1.1). An ACCS-wide data dictionary is planned. Analysis has included an STC investigation on the applicability of

48 (U) ADSIA WG4 has been given a Priority One task to develop a Link 1 replacement; ADSIA WG4 has asked TSGCEE(SG9) to look at media-independent protocols for such a concept.

ASN.1 and its relation to the syntax of STANAG 5500 (FORMETS). There is a concern as to whether use of FORMETS would permit achieving the full benefit of the OSI model.

(U) The following considerations in ACCS indicate some elements of the technical approach for achieving interoperability:

- ACCS interfaces will be required to the following generic external agencies/systems:
  - NATO intelligence systems (e.g., BICES, NMOS)
  - NATO army headquarters
  - NATO land-based maritime headquarters
  - NATO maritime forces afloat
  - National headquarters, intelligence, army headquarters, maritime headquarters, territorial commands, meteorological services, civilian air traffic control, and local authorities.
- Requirements have been identified for free text traffic (electronic mail), graphics, and facsimile transmission services. Video transmission is a potential long-term requirement for ACCS, but it has been excluded from consideration for the current ACCS planning time frame (1990s).
- Two ADSIA standardization documents have been considered important for ACCS in the area of formatted messages:
  - ADatP-3/STANAG 5500, containing a catalogue of character-oriented formatted messages
  - Common Information Exchange Glossary (CIEG), containing terms and definitions applicable to the development of both bit- and character-oriented procedural standards.
- ACCS requires an electronic mail service. The planned standard is the Military Message Handling System, based on CCITT X.400 (see Section 10.3.8).
- ACCS further requires automated interactions between databases (e.g., updates) that could be event driven. The FTAM standard has been recommended for consideration for ACCS use, particularly for bulk update of databases.
- The functions (e.g., syntax and formatting rules) of ASN.1 and the associated Basic Encoding Rules (BER) were recognized by the ACCS Team as potentially richer and offering greater scope than NATO Message Text Formatting System (FORMETS) functions of ADatP-3/STANAG 5500. Large investments in FORMETS are being made in operational systems, and NATO interoperability continues to be based on FORMETS and ADatP-3. Eventually, however, FORMETS could be replaced by ISO standards for automated data exchange to make better use of the functionality of the OSI model and the richness of ISO standards. There are potential problems in ensuring interoperability between systems using FORMETS and systems using ISO standards. Investigation is needed on whether the use of an information

structure based on ADatP-3 message contents is a sufficient basis for achieving backwards interoperability with FORMETS systems.

- ACCS anticipates the use of gateways for data forwarding (message standard translation), trusted secure interfaces between cooperating ADP systems to control access to data, and physical interconnection of different communication systems.
- A connection-oriented virtual call protocol has been proposed for ACCS, rather than a connectionless (or datagram) protocol, as the basis for packet switched services. Virtual call services are widely used in civil networks; they can result in more efficient transmission because of significantly lower packet overheads, and they can simplify network management. An issue is whether virtual call would provide adequate flow control under stress conditions. Limited use of a connectionless service may also be required.

11.4 Battlefield Information Collection and Exploitation Systems (BICES)

(U) The Battlefield Information Collection and Exploitation Systems (BICES) will provide intelligence support for the ACE ACCIS, including the land-surface picture for NATO. BICES is a project under the direction of TSGCEE PG7. BICES will consist of three segments, which will utilize either national or NATO intelligence capabilities [Ref. 297]:

- Higher national segment includes national capabilities at the MOD-DoD and Theatre Level
- Lower national segment includes national capabilities below NATO PSCs
- The NATO segment of BICES, as the hub of the interconnected systems, will include the NATO capability at the NATO command level (a portion of ACE ACCIS).

(U) The BICES concept will involve integration of national and NATO systems, initial processing, processing/fusion, and user exploitation. The BICES capability will be integrated into the ACE ACCIS. Specifically, the ACE portion of BICES (and NMOS) will go under the SD&IC activity of the ACE ACCIS. Configuration management for BICES will fall under configuration management of ACE ACCIS. User requirements for the ACE segment of BICES are completed [Ref. 298], but the majority of the national annexes have not yet been provided. One national operational capability has been designated as part of BICES, namely the Limited Operational Capability-Europe (LOCE) system developed by the US.

(U) Among the approaches being considered for BICES are a common database and a data dictionary, whose scope and content are to be determined. NATO OSI standards from ISO and CCITT will be used unless they cannot meet the BICES requirements.

11.5 NATO Maritime Operational Intelligence Support (NMOS)

(U) The NATO Maritime Operational Intelligence Support (NMOS) will also provide intelligence support for the ACE ACCIS. NMOS provides the naval surface and subsurface picture for NATO. NMOS is a joint project under SACLANT, SHAPE, and CINC-CHAN. The only standards identified for NMOS that are not part of the NATO Common Interface Standards are additional STANAG 5500 (ADatP-3) messages [Ref. 299]. The Military Committee approved the Tri-MNC concept for NMOS early in 1987 [Ref. 300].

11.6 Quadrilateral Interoperability Programme

(U) The Quadrilateral Interoperability Programme is an initiative of four nations--France, Germany, United Kingdom, and United States--to develop and implement, for the short term, an interface through which the four national ACCISs [respectively Systeme Informatique de Commandement des Forces Terrestres[49] (SICF), Heeres-Fuehrungsinformationssystem fur die rechnergestuetzte Operations-fuehrung in Staeben[50] (HEROS), WAVELL, and Maneuver Control System (MCS)] can interoperate. Software development for the national systems has been completed, and an interoperability demonstration was successfully conducted in May 1990 near Ingostadt, Germany [Ref. 301]. Meetings were held in June and July of 1990 to explore options for fielding initiatives based on the Quadrilateral Interoperability Programme standards.

(U) The Quadrilateral Tactical Interface Requirements (QTIR) document [Ref. 302] expresses the basic requirements. The Quadrilateral Technical Interface Design Plan (QTIDP) [Ref. 303] specifies, for the gateway, the technical interface based on the ISO/CCITT OSI Reference Model. The operational requirements specify for information representation the use of formatted messages as described in STANAG 5621 Edition 2 and in accordance with ADatP-3 (STANAG 5500) specifications. The specifications for the common international interface between national gateways are provided in the QTIDP by annexes describing each of the seven layers with options and parameters derived from

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[49] (U) Information System For Command of Ground Forces (SICF).

[50] (U) Army Command and Control Information System for the Computer Assisted Conduct of Operations within Staffs (HEROS).

ISO/CCITT standards in order to meet the specific military requirements (e.g., naming, addressing, priority, sensitivity, size of messages, and segmenting).

(U) Standards specified in the QTIDP are identified in Table 38. Specifications of Layers 1 through 5 are closely related to ISO standards. Layer 6 (presentation) is a null layer. Layer 7 specifies message handling functionality based on the CCITT X.400 standards for the subset of service elements provided by the P1 and P2 protocols and the service elements provided by Reliable Transfer Service (RTS), as defined by ISO 9066-2, and integrated with the Association Control Service Element (ACSE, ISO 8649 and ISO 8650) that provide support for other application entities. The Quadrilateral Test and Demonstration Management Plan (QTDMP) [Ref. 304] specifies a plan for interface testing and interoperability testing before performing the 1990 demonstration. Most of the interoperability parameters are specified by the options, classes, and system parameters selected from ISO/CCITT standards; some of the other interoperability parameters are defined in accordance with military requirements defined for messages in the QTIR.

(U) A preliminary review has shown that all standards, stacks, and options for the Quadrilateral Interoperability Programme that are also relevant to ATCCIS have been identified in earlier chapters of this working paper. In addition, a separate analysis [Ref. 305] has been performed that identifies a large number of interoperability parameters and provides their values.

Table 38. (U) Standards for Quadrilateral Interoperability Programme

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Layer	References for Standards
7. Application	ISO 8649-1986 (ACSE) ISO 8650-1986 (ACSE) CCITT X.400, X.401, X.408, X.409, X.411, X.420 DIS 9066.1, 9066.2 (Reliable Transfer) DIS 8824 (ASN.1) DIS 8825 (ASN.1 Basic Encoding Rules) IS 646, IS 6937 (Coded Character Sets)
6. Presentation (Null Layer)	DIS 8822-1985 DIS 8823-1985
5. Session	DIS 8326-1984 DIS 8327-1984
4. Transport	DIS 8072-1984 DIS 8073-1984
3. Network	ISO 8208-1985 (X.25 PLP) DP 8348 (CONS) DP 8472 (Network Convergence Protocol) DIS 8648-1985 (Internal Organization Network Layer) DP 8878-1984 (X.25 CONS) CCITT X.25-1984 STANAG 4214 (Internal Routing) STANAG 5046 (Communications Directory)
2. Data Link	ISO 7776-1985 (HDLC LAPB) DIS 8886-1985 ISO 3309 (HDLC Frame Structure) ISO 4335 (HDLC Procedures)
1. Physical	ISO TR 7477-1985 DIS 8481-1985 ISO/TC97/SC6 N3473 (DP 10022) ISO 4903 CCITT V.3, V.10, V.11, V.28 CCITT X.21, X.24, X.25 CCITT X.27 (EIA/RS-422-A)

Note: The table shows the status of standards at the time the QTIDP was specified.

11.7 Standard Automated Message Interface for NATO's ACCISs (STAMINA)

(U) This summarizes the results of a review of the specifications for STAMINA [Ref. 306]. STAMINA is being developed by an Interface Working Group of NATO

Communications and Information Systems Agency (NACISA) to be used as a standard interface for passing information among ACCISs. Initial demonstrations are planned for the Central Region ACCIS and three target systems: the Allied Command Baltic Approaches Command and Control Information System (ACBA CCIS), the Central Region Alternate War Headquarters CCIS (CR AWHQ CCIS), and the Allied Tactical Operations Centre CCIS (ATOC CCIS, also known as the EIFEL Follow-On). STAMINA is planned to be used for such interfaces as [Ref. 307]:

- Central Region (CR) ACCIS to UKAIR ACCIS and to EIFEL (ATOC)
- SHAPE and CR Primary War Headquarters (HQ) to SHAPE and CR Mobile Alternative HQ
- ACBA (Baltic Approaches) ACCIS to CR ACCIS and to EIFEL (ATOC).
- Various interfaces at SHAPE HQ.

(U) STAMINA consists of two separate transport profiles and an X.400-oriented application profile. The transport profiles support (1) X.25 packet switched networks for use in CR ACE and (2) permanent analogue circuits for point-to-point interfaces using dedicated analog circuits. A third transport profile, switched analog circuits for use with the NATO IVSN analog voice network, has recently been deleted, as there have been no interest shown in implementing this aspect of STAMINA.

(U) The entire STAMINA profile has been adopted by TSGCEE SG9 an intercept profile for the *NTIS Transition Strategy* [Ref. 308]. In the future STAMINA could be considered as several NATO standardized profiles.

(U) Requirements for the Quadrilateral Interoperability Programme and STAMINA overlap, but it is not clear at this time if they will converge. Generally, STAMINA attempts to provide military features (e.g., four levels of precedence and NATO classifications) as "extensions" in Layer 7.[51] Further, STAMINA provides three transport protocols (using Class 0 and Class 2), whereas the QTIDP provides just one (using Class 2) [Ref. 309].

11.7.1 STAMINA Application Profile

(U) The STAMINA application profile for message handling is a modification of CCITT X.400(MHS)-1984 18 military features were added. These features are identified in Table 39. STAMINA messages are free text and text formatted according to the ADatP-3 specification [Ref. 310].

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[51] (U) STAMINA leaves the commercial P1 and P2 sublayers unmodified and defines new service elements as extensions to P2; the QTIDP redefines both P1 and P2.

Table 39. (U) Military Features Added to the STAMINA Specification

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	Military Feature	Description
1.	Extended Authorization Info	Date and time officially authorized
2.	Subject Indicator Code	Eight subject codes for distribution information
3.	Primary Precedence	Grades of delivery (e.g., urgent, normal) for primary recipient
4.	Copy Precedence	Grades of delivery for copy recipient
5.	Security Classification	Five classifications (e.g., NATO UNCLASSIFIED)
6.	Security Category	E.g., ATOMAL, EYES ONLY
7.	Originator Identifier	Originating organizational unit message reference
8.	Address List Indication	Address list type and identifier; on origination conveys multi-destination delivery; on receipt, forwarding action
9.	Clear Indication	Transmitted without any security classification
10.	Codress Message Indicator	Indicates a codress encrypted message
11.	Corrections	Corrections are required in body of text
12.	Exempted Address	Exempted name(s) from accompanying address list
13.	Handling Instructions	Handling instructions accompany the message
14.	Message Instructions	Message instructions accompany the message
15.	Message Type	Distinguish between normal and exercise traffic
16.	Other Recipient Indicator	Identifies other recipient(s) also intended to receive message
17.	Pilot Forwarded	Used in forwarding a message
18.	Security Policy Indentifier	Identifies a security policy

(U) The application profile has two types of user access:

- Private Message Handling Service (MHS) Access: UA and MTA, PRMD to PRMD, A/3211 (based[52] on CCITT X.400-1984 and ISO 8327)
- Military Private MHS Access: UA and MTA, PRMD to PRMD, A/3211(M) (based on CCITT X.400-1984, ISO 8327, ACP 117, and ACP 127).

The A/3211 application profile is the X.400 MHS, in which the Application Layer (Layer 7) has three sublayers: User Agent Layer defined by X.420, Message Transfer Layer defined by X.411, and Reliable Transfer Server defined by X.410. The A/3211 Presentation Layer (Layer 6) is defined by ISO 8823 (based on X.410), and the Session Layer (Layer 5) is defined by ISO 8327 (based on X.410).

(U) STAMINA applications profile and the Quadrilateral Profile (QP) are both military versions of CCITT X.400(MHS)-1984. The QP is being developed and used by four command and control system programs in FR, GE, UK and US. The QP has a single transport profile based on X.25. To understand some of the essential differences

52 (U) STAMINA Version 3.0 [Ref. 27] also cites "ISO 8322" for T/3211 and T/3211(M), but this standard does not exist.

between STAMINA and QP, note that Layer 7 of X.400-1984 consists of the User Agent (UA), the Message Transfer Agent (MTA), and the Reliable Transfer Agent (RTA). The RTA serves as the liaison with the Session Layer protocols (in X.400-1984, the Presentation Layer is a null layer; i.e., there is no layer 6, so Layer 7 liaises directly with Layer 5). Both the UA and MTA use peer (e.g., UA-to-UA) protocols to communicate to distant UAs and MTAs. The peer protocol for the UA is the Interpersonal Messaging Protocol (P2), while the peer protocol for MTA-to-MTA communication is the Message Transfer Protocol (P1). Thus, P1 defines the relaying of messages among MTAs, while P2 defines the service elements of the interpersonal messages exchanged by UAs. The STAMINA profile provides military features by extending P2 (using a "superset" approach), permitting these features to be mapping into similar commercial features in the P1 protocol without affecting lower layer protocols, whereas the QP changed both P1 and P2 in such a way that the changes affected services in lower protocol layers as well.

11.7.2 STAMINA Transport Profiles

(U) STAMINA includes selection of CCITT and ISO standards--along with allowable options and parameters--necessary to attain interoperability among the end systems. STAMINA is based profiles defined in the SPAG User's Guide [Ref. 236]. The STAMINA transport profiles are:

- Permanent Telephonic Circuit Providing Connection-Oriented Network Service, T/21(M)
- Telephonic Switched Circuits Providing Connection-Oriented Network Service, T/22(M)
- Permanent Access to Packet Switched Data Network (PSDN), OSI Connection-Mode Services, T/312(M)

Table 40 identifies the standards specified for the STAMINA transport profiles. The current standard for STAMINA is Version 4.0, April 1990 [Ref. 311].

Table 40. (U) Standards for STAMINA Transport Profiles

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Layer	Transport Profiles T/21(M)	T/22(M)	T/312, T/312(M)
4. Transport	ISO 8072 ISO 8073[a]	ISO 8072 ISO 8073[a]	ISO 8072 ISO 8073[a]
3. Network	ISO 8348 ISO 8208 ISO 8878 STANAG 4214 STANAG 5046	ISO 8348 ISO 8208 ISO 8878 STANAG 4214 STANAG 5046 CCITT V.25 CCITT V.25bis	ISO 8348 ISO 8208 ISO 8878 STANAG 4214 STANAG 5046
2. Data Link	ISO 7776[b]	ISO 7776[b] CCITT V.25 CCITT V.25bis	ISO 7776[b]
1. Physical	CCITT V.24 CCITT V.11 ISO 2110 ISO 4902 MIL-STD-188C	CCITT V.24 CCITT V.11 ISO 2110 CCITT V.25 CCITT V.25bis MIL-STD-188C	CCITT X.21 CCITT V.11 ISO 2110 ISO 4902 ISO 4903 MIL-STD-188C CCITT X.21bis

[a] Class 0 (Simple) and Class 2 (Multiplexing) are mandatory; Class 4 (Error Detection and Recovery) is optional.

[b] Options 2 and 8 of ISO 7809 (Balanced Asynchronous Class) are mandatory; Option 10 may be included under bilateral agreement.

11.7.3 STAMINA Development Activities

(U) One current activity is addressing the need to add functionality required to support relays between X.400 and ACP-127 message domains, as recommended by TSGCEE and recommended by the *NATO C3 Architecture* and the *NATO C3 Master Plan.* In addition, STAMINA is building a database of the interoperability parameters (e.g., speeds for communications lines) chosen by implementors of STAMINA specifications. Some parameters must be identical for interoperability and others must fall within certain ranges. The database will also tract some parameters that others not affect interoperability. STAMINA is also planning to develop a conformance test suite and a file transfer functional profile (based on FTAM). A

new transport profile is being developed for digital circuit switch connections for communications supporting the SHAPE and CR Mobile Alternate War HQ. The current STAMINA application profile will be implemented in the STC testbed. Finally, STAMINA has an initiative, not yet under contract, for an Automated Message Processing System (AMPS), intended to automate message processing at various ACE commands.

(U) The Configuration Management Board (CMB) for STAMINA has agreed [Ref. 312] to add the additional military features to the X.400 specification, making it identical to MMHS(84). The new Version 4.0 of STAMINA should be reviewed for such compliance. The CMB has decided to omit one part of STAMINA, the Transport Profile for Analog Circuit Switch, which was seen as high risk and for which no interest has been expressed from implementors. A consultant contract is planned to develop a conformance test suite for STAMINA, to be delivered at the end of 1990. An FTAM application profile is to be developed; the effort is now in a pre-contract award stage and a product is expected at the end of 1990. There are plans to develop another transport profile for STAMINA for digital circuit switched communications. NACISA is interested in studying the compatibility of STAMINA with the 1988 standards, with an orientation to migrate toward a 1988 base or, alternatively, define an interface module between the 1984- and 1988-based systems.

(U) Some STAMINA parameters are left to be determined by the implementors of an interface, and some of these must be the same on both ends of the interface. NACISA has developed a database in which to record the parameters used on all STAMINA implementations. NACISA has begun to develop a new project called the Automatic Message Processing System (AMPS). It appears at this early stage that it will have two aims [Ref. 313]:

- To provide individual ACE HQs with automated processing capability internal to each HQ for generation of outgoing messages and to provide the processing of incoming messages. Initially, the messages will be transmitted via the existing TARE system using TARE-unique protocols. Where possible, the internal processing will be based on X.400 oriented systems.
- To use the AMPS at each HQ as the platform for the eventual replacement of the TARE with an X.400 oriented network.

AMPS is expected to be based on X.400(88) rather than on STAMINA or MMHS(84), and NACISA plans to work closely with SG9 for the standards.

(U) An ACE ACCIS Integrated Testbed is planned for the SD&IC efforts and the BICES Pilot Study (BPS) efforts, with NACISA serving as the host nation and STC providing scientific expertise and the home of one of the testbed nodes. SHAPE will provide personnel to implement STAMINA on this testbed, as well as other protocols that may emerge from the SD&IC or BPS.

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12. CONCLUSIONS AND RECOMMENDATIONS

(U) This section summarizes the gaps in current and planned standards coverage and identifies possible courses of action for addressing these deficiencies. Figure 16 identifies standards applicable to ATCCIS in five groups: management, user interface, systems and applications interface, information and data services, and communications services. The initial letters of these groups form the word MUSIC and the groupings are patterned after proposals from the CCTA in the UK. In addition to the four Basic Facilities, Figure 16 depicts other elements of the ATCCIS architecture and shows their relation to the five groups of standards:

- Application-level facilities (ALFs)--provide automation support for command and control key tasks.
- Man-machine interface (MMI) service facility (MSF)--provides the functionality for a generalized interface between ALFs and users, irrespective of the particular devices used to interact with users and the human-computer interface they implement.
- Input-output facilities (IOFs)--provide an interface between an ATCCIS-conformant system and a particular class of non-ATCCIS-conformant systems. Example profiles for an IOF are the STAMINA profile and the Quadrilateral Interoperability Programme profile, both discussed in Chapter 11.

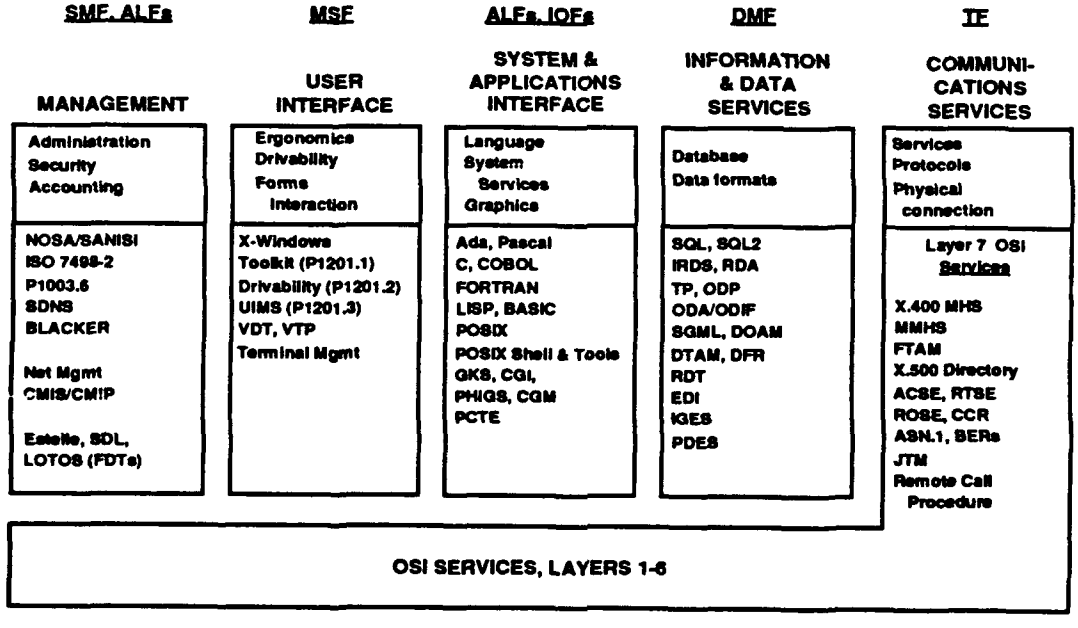

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Figure 16. (U) Overview of Standards Applicable to the ATCCIS Architecture

12.1 OSI Technical Standards

(U) While TSGCEE has identified and assessed eight military features that need to be incorporated in commercial OSI standards for use in military systems, little detail has yet been released (e.g., in drafts of STANAGs 4251-4266) to show how these features can actually be addressed in military versions of OSI standards. WG1 and WG2 of TSGCEE SG9 are continuing to progress drafts of such standards, but it is too early to assess the degree to which the military features will be provided. TSGCEE SG9 has an ambitious 18-month plan for progressing the NATO OSI data communications standards, but without increased support from the Nations it does not appear that all the stated objectives will be reached. It appears unlikely that a stable set of NATO OSI standards addressing the full range of OSI options will be approved before the mid-1990s. Also, efforts to incorporate military requirements in civil standards and initiatives to obtain commercial products with the desired military features may not be successful until the late 1990s. Clearly, with limited resources, an evolutionary plan is needed that reflects carefully analysed priorities for progressing NATO technical standards for OSI and other open systems capabilities.

(U) There is a need to reassess and revalidate the military features that are the basis for the work by TSGCEE and the Nations to ensure military requirements will be met by the standards to be adopted. The initial views on the required military features developed in the early 1980s were based, to some degree, on concepts to support manual communications centers. Experience since that time with automated communications facilities could lead the reassessment to different results on what military features are not yet supported by civil standards. As an example, fewer levels of precedence might be acceptable than were previously determined, and different measures of quality of service might be defined.

(U) There is a need to identify additional resources and possibly new approaches to expedite the completion of the initial OSI data communications STANAGs. The scope and diversity of the applicable OSI and OSI-related standards activities in the civil sector is expanding rapidly. Some features needed by the military are already being addressed by existing and emerging international standards. Initial OSI data communications STANAGs are needed as soon as possible to provide a concrete step in the transition strategies for the NATO nations and agencies. The work plans by TSGCEE SG9 WG1 and WG2 address many of the important technical areas, but these groups are having difficulty in maturing the full set of draft STANAGs in a timely fashion.

(U) A significant issue regarding military features for OSI technical standards is whether these features can be specified as extensions or options to the commercial standards or, alternatively, whether some of the features mandate deviations and hence noncompliance with the base commercial standards. Whenever military features can be provided through extensions or new options to existing commercial standards, the specifications for the services and protocols could be offered to the international standards bodies and the nations could seek to have these changes made part of the standard. In such cases, commercial implementations of the military features could be expected at a much lower cost than if military-unique deviations had to be supported.

(U) If NATO and the nations are not successful in defining the military features or if they are not fully addressed by the international commercial standards, as either extensions or options, then the following actions should be considered, presumably by TSGCEE:

- Assess the functionality of the ISO/CCITT standards against the proposed military requirement
- Assess the operational impact of not meeting the requirement in CCISs for data communications
- Identify cost(s) associated with implementing a nonconformant, military-unique standard
- Refer the results back to an operational body within NATO to determine if the added functionality is cost-justified in accordance with memorandum of agreement procedures.

12.2 Other Technical Standards

(U) Data standardization is needed to support the development of ATCCIS. Since data standardization addresses the representation of data as well as data management, data element standardization, and naming conventions, it requires not only technical but also procedural and operational standards. Data standardization issues and recommendations are addressed in WP 7L, *Operational and Procedural Requirements for Data Management and Standardization.*

12.3 Recommendations

(U) The following recommendations are made in the area of progressing the technical standards:

a. TSGCEE SG9 should continue the current efforts to reassess and revalidate the military features that do not appear to be provided by existing and emerging civil standards.

b. TSGCEE should identify additional resources and possibly new approaches to expedite the completion of the initial OSI data communications STANAGs. As examples, the nations could increase the resources provided to TSGCEE SG9 and more active participation by civil agencies and contractors could be considered.

c. The nations should seek wherever possible to influence the international and national standards bodies to incorporate the military features identified by TSGCEE SG9 into the civil standards. Specifically, the nations should support initiatives in ISO to expand work in areas of interest to the military. Examples are the ISO questions on whether to continue architectural work on multipeer data transmission and on quality of service.

d. The military organizations of the nations should actively participate in international and national civil standards bodies to ensure that military requirements are addressed by the emerging open systems standards.

e. TSGCEE should adopt International Standardized Profiles whenever possible and should seek international recognition of additional profiles where they are needed for military systems.

f. TSGCEE should develop and adopt a plan to ensure that a set of NATO OSI STANAGs is available in the mid-1990s, even if adopting this plan means postponing the incorporation of some low priority requirements. This plan, including a schedule for the release of the OSI STANAGs, should be included in the next draft of the *NTIS Transition Plan* developed by TSGCEE SG9.

g. The *NTIS Transition Plan* should be expanded to include additional standards and specific profiles of standards recommended for use by ACCS, ACE CCIS, ATCCIS, BICES, and other major NATO projects until a complete set of NATO OSI STANAGs have been promulgated.

   (1) The profiles should include support for the exchange of information through database-to-database transfers as well as for STANAG 5500 messages and the data link to replace Link 1 (as required by ACCS).

   (2) The profiles should include support for ISDN.

   (3) The standards should include those for graphics interfaces and language bindings, document and picture interchange, remote data access, the reference model for data management, transaction processing, and open distributed processing.

APPENDIX A

THE USE OF INTEROPERABILITY PARAMETERS TO ENSURE STANDARDS COVERAGE

THE USE OF INTEROPERABILITY PARAMETERS TO ENSURE STANDARDS COVERAGE

1. INTEROPERABILITY PARAMETER METHODOLOGY

1.1 General

(U) This section describes a methodology for ensuring adequate standards coverage through detailed analysis of the parameters that are required to achieve interoperability against specific standards that control these parameters.

1.2 Description of the Methodology

(U) An Interoperability Parameter (IP) is a system or design parameter whose control is required to achieve interoperability. These parameters are identified in system specifications, interface control documents, and other requirements documents prior to or very early in the system development process. In many cases, the interoperability parameters are controlled through the specification of a range of standards. The assembled parameters act as a checklist for interoperability, since each IP must be controlled by a suitable standard. The purpose of an analysis using IPs is to recognize and examine all relevant quantities and characteristics in a direct manner, instead of assuming that existing or draft standards will provide adequate coverage of the quantities.

(U) One of the underlying principles for the ATCCIS concept is that specifying standards is essential to ensuring interoperability. However, it cannot be emphasized too strongly that specifying standards alone will not guarantee interoperability. Indeed, every standard has a number of design parameters or IPs whose values may need to be fixed in the design phase of implementation. To ensure interoperability, each of these IPs must also be specified and controlled. Some IPs are very general and may be used to specify a class of options or mode of operation. Other IPs may be very detailed, such as restrictions on timing, format size, or bandwidth.

(U) IPs can be identified and appropriately controlled in any stage of system development, from initial concepts and requirements to detailed design and as-built specifications. Parameters may simply be the identity of governing specifications (e.g., standards) for interface or other requirements. They could be the identity of options or specification of limits on performance requirements. They could include lists of services or routines that are mandated or that are denied for use. IPs may include logical or physical layouts that show such elements as sequences, relationships, interconnections, and logical block diagrams. IPs may include waveforms. They may include operating procedures, such as dial settings. In short, IPs include any information item that needs to be controlled at any stage of development to ensure interoperability.

(U) Because each standard is a reflection of the degree to which agreement can be reached in a service area, many important attributes (i.e., IPs) are often left unspecified or unaddressed. As agreements are reached over time, the standards will improve by addressing more functionality and harmonizing conflicting approaches. In cases where standards identify extensions and other types of options, great care must be taken in standards specification and IP control to ensure that, whenever an extension or option is permitted, every implementation of the related service also supports this extension or option. This principle is especially important in achieving not only interoperability but also portability of applications from one implementation or environment to another, such as is needed when operating systems, data management systems, interface packages, and hardware are upgraded.

1.3 Examples of Interoperability Parameters

(U) This section provides a brief introduction to interoperability parameters by examining portions of three sets of standards:

- Physical standards for 25-pin connectors (i.e., EIA RS-232D interface)
- Electrical characteristics of digital interface circuits (i.e., EIA RS-423A and QSTAG 594)
- Transmission characteristics for single channel radio (i.e., STANAG 4202).

1.3.1 Physical Standards for 25-pin Connectors

(U) Table A-1 identifies a number of electrical and mechanical interoperability parameters controlled by EIA RS-232D for 25-pin connectors. The first two columns provide the definition of the interoperability parameter; the values specified in the standard, if any, are given in the third column.

Table A-1. (U) Example Interoperability Parameters Based on Characteristics of Unbalanced Load Digital Interface Circuits, 25-Pin Interface Connectors

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Description of Interoperability Parameter		Example Value of IP
EXAMPLE ELECTRICAL CHARACTERISTICS:		
Undefined condition	Minimum voltage Maximum voltage	-3 volts +3 volts
Marking condition (binary ONE)	Interface Voltage Maximum	-3 volts
Spacing condition (binary ZERO)	Interface Voltage Minimum	+3 volts
Restriction on use of hysteresis techniques to enhance noise immunity		None
Load impedance of the receiver side	Minimum for applied voltage ≤ 25 volts Maximum for applied voltage of 3 to 25 volts	3,000 ohms 7,000 ohms
Effective shunt capacitance of receiver	Maximum	2,500 picofarads
EXAMPLE MECHANICAL CHARACTERISTICS:		
Number of Pins		25
Cable length	Maximum	Not specified
Connector length (male contacts, female shell)	Minimum Maximum	38.84 mm 39.09 mm
Connector width (male contacts, female shell)	Minimum Maximum	8.23 mm 8.48 mm
Contact spacing, Pin #1	Longitudinal offset Lateral offset	+16.56 mm +1.42 mm
Contact spacing, Pin #2	Longitudinal offset Lateral offset	+15.19 mm -1.42 mm
Contact spacing, Pin #25	Longitudinal offset Lateral offset	-16.56 mm +1.42 mm

Table A-1. (U) (Continued)

UNCLASSIFIED

Description of Interoperability Parameter		Example Value of IP
Pin diameter	Minimum	0.98 mm
	Maximum	1.06 mm
Pin length, overall with mounting	Minimum	9.77 mm
	Maximum	10.03 mm
Pin mounting length	Minimum	1.57 mm
	Maximum	1.76 mm
Female contact length, overall with mounting	Minimum	9.27 mm
	Maximum	9.63 mm
Female contact socket depth	Minimum	7.37 mm
	Maximum	7.37 mm
Pin assignment	Pin #1	Shield
	Pin #2	Transmitted Data (BA)
	Pin #5	Clear to Send (CA)
	Pin #25	Test Mode (TM)
Female contact socket depth	Minimum	7.37 mm
	Maximum	7.37 mm

Sources:

(1) DIS 2110, *25-Pin DTE/DCE Interface Connector and Pin Assignments* (related to EIA RS-232C), November 1985.

(2) EIA RS-232D, *Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, 1986.

(3) EIA RS-449, *General Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, November 1977.

(4) EIA Industrial Electronics Bulletin IEB-12, *Application Notes on Interconnection Between Interface Circuits Using RS-449 and RS-232C*. November 1977.

1.3.2 Electrical Characteristics of Digital Interface Circuits

(U) Table A-2 identifies interoperability parameters of digital interface circuits that are controlled by QSTAG 594. These are all electrical characteristics.

Table A-2. (U) Example Interoperability Parameters Based on Electrical Characteristics of Unbalanced Load Digital Interface Circuits

UNCLASSIFIED

Description of Interoperability Parameter		Example Value of IP
Open circuit voltage, generator	Minimum magnitude Maximum magnitude	4 volts 6 volts
Test termination voltage, generator	450 ohm ±1% test load min	90% magnitude of open circuit voltage
Short circuit current, generator	Maximum magnitude	150 mA
Output leakage current, current, generator	Maximum magnitude with applied voltage from -6 V to +6 V	100 μA
Output signal waveform voltage	Minimum magnitude Maximum magnitude Variance between transitions	3.6 volts 6 volts Within 10% steady state
Output signal waveshaping	Rise time to 90% steady state at maximum signaling rate Minimum Maximum Rise time to 90% steady state at signaling rates below 1 kb/s Minimum Maximum	 0.1 unit interval 0.3 unit interval 100 μsec 300 μsec
High impedance state	Requirement Output voltage at high imped and 450 ohm ±1% test load	Optional Zero (nominal)
Wire or cable	Characteristics	Not addressed
Signaling rates		Not specified
Total load	Resistance minimum Required differential input voltage to achieve intended binary state	400 ohms 200 mV
Fail safe	Requirement	Optional

Sources:

(1) QSTAG 594, *Electrical Characteristics of Digital Interface Circuits,* 25 March 1981 (adopts MIL-STD-188-114).

(2) MIL-STD-188-114A, *Electrical Characteristics of Digital Interface Circuits,* 30 September 1985 (Revision of MIL-STD-188-114 dated 24 March 1976).

(3) CCITT V.10/X.26, *Electrical Characteristics for Unbalanced Double-Current Interchange Circuits for General Use With Integrated Circuit Equipment in the Field of Data Communications,* 1985 (related to EIA RS-423A, which is compatible with MIL-STD-188-114A).

(4) EIA RS-423A, *Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits,* December 1978.

1.3.3 Transmission Characteristics for Single Channel Radio

(U) Table A-3 presents a nearly complete summary of the interoperability parameters controlled by STANAG 4202 for single channel radios. This standard is in use in NATO as the basis of interoperability for digital data transmission on combat net radio.

Table A-3. (U) Example Interoperability Parameters Based on Single Channel Radio Standards (STANAG 4202)

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Description of Interoperability Parameter		Example Value of IP
Frequency band	Minimum frequency Maximum frequency Channel spacing	Not specified Not specified Not specified
Transmission rates (1)	Preferred rate Other required rates	600 b/s 300, 1,200 (and 150 for HF)
Modulation	Type	FSK
Data	Character coding type	NATO 7-bit
FSK modulation	Mark (or 1) frequency Space (or 0) frequency Audio tone frequency accuracy, transmit Receiver accuracy	1575 Hz 2425 Hz ± 5 Hz (± 1 Hz desired) ± 20 Hz
FSK transition between mark & space	Maximum phase discontinuity	5 degrees
FSK timing	Minimum clock accuracy for synchronous data	± 1 part in 10**5
Keytime delay	Required Options Modulation applied	0.53333, 2.026676 sec Multiples of 0.10667 sec (2) Reversals ending in a zero
Bit synchronization preamble	Length Modulation	33 bits Reversals ending in a "1"
Character synchronization preamble	Length Modulation	63 bits Pseudo-random sequence generated by a (6,1) shift register starting with "111111"
Message preparation for transmission	Initial character follows) Message structure Message padding	"SI" or "NUL" (clear, respectively, encrypted text 7-bit bytes Up to 6 "1" bits
Cyclic redundancy check (applied to the entire input message)	CRC type Generator (mod 2) Conversion to 8-bit byte Size of check CRC padding	Polynomial x**16+x**12+x**5+1 0 in most significant bit Three 7-bit bytes NATO 7-bit end-of-text chars as required (up to 15) (3)
Envelope termination	Size	Four 7-bit characters NATO 7-bit end-of-text chars

Notes:

(1) STANAG 4202 (Appendix B) provides guidelines for interim use of 16,000 b/s channels that are not shown in this table.

(2) 0.10667 sec is the time to send 128 bits at 1,200 b/s or 64 bits at 600 b/s.

(3) The minimum message is 16x7 or 112 bits and requires 0.19 sec at 600 b/s.

Table A-3. (U) (Continued)

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Description of Interoperability Parameter		Example Value of IP
Error detection and correction coding (applied to 7-bit bytes)	ED&C type	Hamming (12,7), produces 12-bit coding for every 7-bit byte
Time dispersal coding	TDC interleaving array size	16x12, with sixteen 12-bit Hamming codes
Errors	Number of acceptable but uncorrectable errors	None (stop processing and send no NACK)

Source: STANAG 4202 EL (Edition 2), *Transmission Envelope Characteristics for High Reliability Data Exchange Between Land Tactical Data Processing Equipment Over Single Channel Radio Links*, Military Agency for Standardization, NATO, 25 May 1988.

1.3.3 Interoperability Parameters for X.25 Packet Switching

(U) Table A-4 provides the interoperability parameters for the Implementor's Agreements on the X.25 packet switching protocol as defined in the 1989 NIST Workshop stable agreements that apply to US GOSIP Version 1.0.[1] The NIST Workshop understands that agreement to these interoperability parameters will ensure interoperability of implementations of the X.25 protocols.[2]

2. USING INTEROPERABILITY PARAMETERS TO CHARACTERIZE MILITARY FEATURES IN OSI-RELATED TACTICAL STANDARDS

(U) This section is intended to be expanded to demonstrate the use of interoperability parameters to describe how some fielded tactical data systems are implementing military versions of OSI standards to achieve interoperability. The descriptions here extend the tables provided in Chapter 9 to describe the Quadrilateral Interoperability Program and STAMINA. Examples will also be taken from Appendix C, National Initiatives for Military Use of OSI Standards.

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1 (U) *Stable Implementation Agreements for Open Systems Interconnection Protocols*, Version 2, Edition 1, NIST Special Publication 500-16, National Institute of Standards and Technology, December 1988, UNCLASSIFIED.

2 (U) Private communication with Director, Systems and Network Architecture Division, NIST, 25 May 1989.

Table A-4. (U) Interoperability Parameters for X.25 Packet Switching

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ISO Layer & Function		Standards Cited	Notes on Interoperability Parameters
-	General	CCITT X.25	• Defines procedures required to describe the DTE side of a CTE/DCE interface for systems attached to subnetworks providing an X.25 interface shall be as defined in ISO 7776 and ISO 8208 as indicated below. • These procedures shall also apply to a DTE operating on a DTE/DTE interface.
3	Network Layer	ISO 8208 (X.25 PLP)	• The elements of ISO 8208 applicable for use depend on the OSI role of ISO 8208 (i.e., provision of CONS, support of CLNP): a. When ISO 8208 is used to support CONS, the optional user facilities in Section 5.1 of ISO 8878 shall be supported. b. When ISO 8208 is used to support CLNP (when providing the CLNS), Permanent Virtual Circuit may be used. • Virtual Call Service is required. • Any mutually agreed window and packet size may be used; however, all DTEs must be capable of supporting a window size of 2, a packet size of 128 octets, and a sequence number modulus of 8. • The Basic RPOA Selection Facility shall be implemented and its use or non-use selectable on a per virtual call basis. (1)
2	Data Link Layer	ISO 7776 (HDLC Procedures-- X.25 LAPB)	• The address assignments are: DTE = A (=11000000 binary) DCE = B (=10000000 binary). On a DTE/DTE interface, one of the DTEs, by a prior agreement, shall use the DCE address. • The modulus shall be 8. • A window size (k) of 7 shall be supported. In addition, other window sizes may also be supported. • The Multilink Procedures are excluded.

Notes:

1. Agreement on the Basic RPOA Selection Facility parameter is an ongoing, not a stable, implementation agreement.

References:

1. Stable Implementation Agreements for Open Systems Interconnection Protocols, Version 1, Edition 1, NIST, December 1988.

2. Ongoing Implementation Agreements for Open Systems Interconnection Protocols: Continuing Agreements, NISTIR 88-3824-2, NIST, February 1989.

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APPENDIX B

FUNCTIONAL PROFILES IDENTIFIED IN THE NTIS TRANSITION STRATEGY

FUNCTIONAL PROFILES IDENTIFIED IN THE NTIS TRANSITION STRATEGY

1. INTRODUCTION

(U) The *NATO Technical Interoperability Standards (NTIS) Transition Strategy* [Ref. 4] is developed by the Tri-Service Group on Communications and Electronics Equipment (TSGCEE) and promulgated by the Conference of National Armaments Directors (CNAD). This appendix identifies the functional profiles identified in the 1989 *NTIS Transition Strategy*. All are based on existing or emerging recommendations developed by international or regional standards bodies. Most are based on recommendations from the European Workshop for Open Systems (EWOS).

(U) The notation used to identify and distinguish the functional profiles is that currently being used by EWOS. This notation will be changed in future editions of the *NTIS Transition Strategy* to the taxonomy developed by ISO in TR 10000. The ISO taxonomy is described in Section 9.3.2.

2. APPLICATION PROFILES

(U) There are four functional profiles identified in Figure B-1:

- A.111, Simple File Transfer
- A.221, Basic Teletex
- A.331, Message Handling Service for Interpersonal Messaging (IPM): IPM End System to IPM End System
- A.332, Message Handling Service for IPM: User Agent (UA) to Message Store (MS).

7	ISO 8571 ISO 8650
6	ISO 8823 ISO 8824 ISO 8825
5	ISO 8327

(a) A.111, Simple File Transfer

7	CCITT - T.60
6	CCITT - T.61
5	CCITT - T.62

(b) A.221, Basic Teletex

7	IPM service MT service MT protocol Reliable transfer Association control	ISO 10021-7/X.420 ISO 10021-4/X.411 ISO 10021-6/X.419 ISO 9066-2 ISO 8650
6		ISO 8823 ISO 8824 ISO 8825
5		ISO 8327

(c) A.331, Message Handling Service: Interpersonal Messaging: IPM End System to IPM End System

7	MS service IPM service MT service MT protocol Remote Operations Reliable transfer Association control	ISO 10021-5/X.413 ISO 10021-7/X.420 ISO 10021-4/X.411 ISO 10021-6/X.419 ISO 9072-2 ISO 9066-2 ISO 8650
6		ISO 8823 ISO 8824 ISO 8825
5		ISO 8327

(d) A.332, Message Handling Service: Interpersonal Messaging: UA to MS

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Figure B-1. (U) Application Functional Profiles

3. TRANSPORT PROFILES

(U) Figure B-2 identifies 20 transport profiles. The first four [B-2(a) to B-2(d)] are for the Integrated Services Digital Network (ISDN):

- T.111x,[1] ISDN Circuit Switched Bearer Services over the Connection-Oriented Network Service (CONS) using the B-Channel (LAP B, X.25/PLP)
- T.121x, ISDN Packet Switched Bearer Services over CONS using the B-Channel (X.31)
- T.122, ISDN Packet Switched Bearer Services over CONS using the D-Channel (X.31)
- T.131x, ISDN Port Access to a Packet Switched Digital Network (PSDN) (X.31, X.32).

4	ISO 8073 classes 0 + 2	
	ISO 8878, ISO 9574	
3	Q.931/I.451	ISO 8208 (X.25/PLP)
2	Q.921/I.441 (LAPD)	ISO 7776 (X.25 LAPB)
1	D-channel	B-channel
	(I.430, ISO 8877)/I.431	

(a) T.111, ISDN Circuit Switched Bearer Services CONS Using B-Channel

4	ISO 8073 classes 0 + 2	
	ISO 8878, ISO 9574	
3	Q.931/I.451	ISO 8208 (X.25/PLP)
2	Q.921/I.441 (LAPD)	ISO 7776 (X.25 LAPB)
1	D-channel	B-channel
	(I.430, ISO 8877)/I.431	

(b) T.121, ISDN Packet Switched Bearer Service CONS Using B-Channel (X.31 Case B)

4	ISO 8073 classes 0 + 2	
	ISO 8878, ISO 9574	
3	Q.931/I.451	ISO 8208 (X.25/PLP)
2	Q.921/I.441 (LAPD)	
1	D-channel	
	(I.430, ISO 8877)/I.431	

(c) T.122, ISDN Circuit Switched Bearer Services CONS Using D-Channel

4	ISO 8073 classes 0 + 2	
	ISO 8878, ISO 9574	
3	Q.931/I.451	ISO 8208 (X.25/PLP)
2	Q.921/I.441 (LAPD)	ISO 7776 (X.25 LAPB)
1	D-channel	B-channel
	(I.430, ISO 8877)/I.431	

(d) T.131, ISDN Port Access to a PSDN (X.31 Case A/X.32)

4	ISO 8073 classes 0 + 2		
V.25 or V.25bis	3	ISO 8208	
	2	ISO 7776	T.71
ISO 2110	1	V.24 ISO 2110	

(e) T.21, Analogue Telephone Circuit, Permanent Circuit (CONS)

4	ISO 8073 classes 0 + 2	
3	ISO 8208	
2	ISO 7776	T.71
1	V.24, ISO 2110 V.35, ISO 2593 V.36, ISO 4902	

(f) T.22, Analogue Telephone Circuit, Switched Circuit (CONS)

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Figure B-2. (U) Transport Functional Profiles

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1 (U) In the ISDN profiles, x=1 for the Permanent case and x=2 for the Switched case.

4	ISO 8073 classes 0 + 2
3	ISO 8208
2	ISO 7776
1	X.21 X.21bis

(g) T.31x, Permanent Access to a PSDN, T.70/CONS

4	Draft STANAG 4264 classes 0 + 2
3	Draft STANAG 4263
2	Draft STANAG 4262
1	Draft STANAG 4261

(h) T.312M, Permanent Access to a PSDN, CONS (Military)

4	ISO 8073 class 0	
3	ISO 8208	X.32
2	ISO 7776	
1	X.25 level 1	

(i) T.321, Switched Access to a PSDN, CONS, Telephone Circuit Access

4	ISO 8073 classes 0,2	
3	ISO 8208	X.32
2	ISO 7776	
1	X.25 level 1	

(j) T.322, Switched Access to a PSDN, CONS, Digital Data Circuit Access

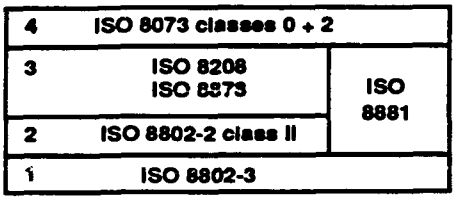
4	ISO 8073 classes 0 + 2	
X.21	3	T.70
	2	T.70
1	CCITT X.21	

(k) T.41, Digital Data Circuit, Telematic End Systems, T.70 Case

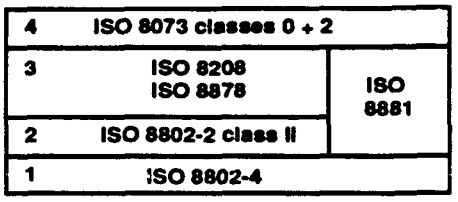
4	ISO 8073 classes 0 + 2	
X.21	3	ISO 8208 ISO 8878
	2	ISO 7776
1	CCITT X.21	

(l) T.42X, Digital Data Circuit, CONS

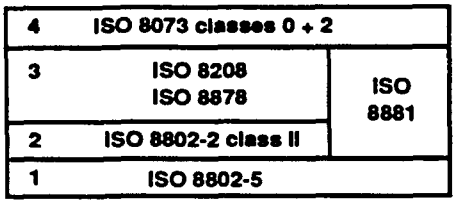
Figure B-2. (U) (Continued)



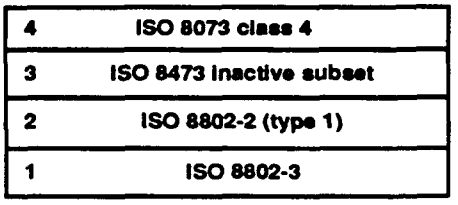
(m) T.611, Local Area Network CSMA/CD, CONS



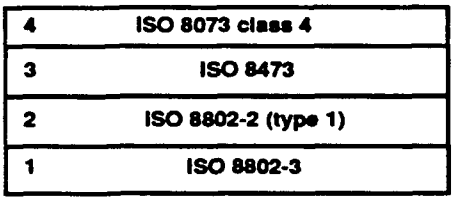
(n) T.612, Local Area network Token Bus, CONS



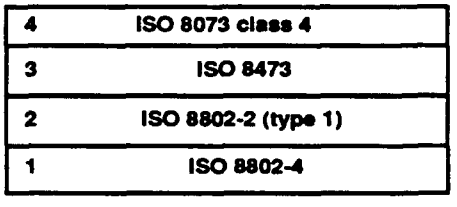
(o) T.613, Local Area Network Token Ring, CONS



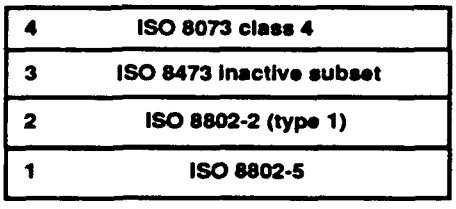
(p) T.6211, Local Area Network CSMA/CD, CLNS Single-LAN Environment



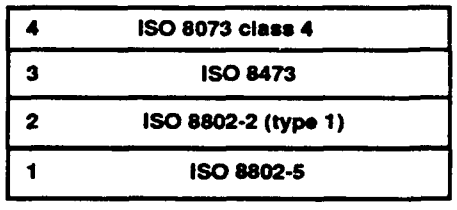
(q) T.6212, Local Area Network CSMA/CD, CLNS Multiple-LAN Environment



(r) T.622, Local Area Network Token Bus, CLNS Multiple-LAN Environment



(s) T.6231, Local Area Network Token Ring, CLNS Single-LAN Environment



(t) T.6232, Local Area Network Token Ring, CLNS Multiple-LAN Environment

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Figure B-2. (U) (Continued)

(U) Two of the transport profiles [B-2(e) and B-2(f)] are for analogue telephone circuits:

- T.21, Permanent Circuit with CONS
- T.22, Switched Circuit with CONS.

(U) Four PSDN transport profiles [B-2(g) and B-2(j)] are shown in Figure B-2:[2]

- T.31x, Permanent Access to a PSDN, Using T.70 (T.311) or CONS (T.312)
- T.312M, Permanent Access to a PSDN with CONS (draft STANAG for military use)
- T.321, Switched Access to a PSDN, Telephone Circuit, Using Transport Protocol Class 0 (TP0) over CONS
- T.322, Switched Access to a PSDN, Data Circuit, Using TP0 and TP2 over CONS.

(U) Two digital data circuit transport profiles [B-2(k) and B-2(l)] are shown in Figure B-2:

- T.41, Digital Data Circuit for Telematic End Systems Using T.70
- T.42x, Digital Data Circuit Using CONS (T.421 for Permanent Circuit and T.422 for Switched Circuit).

(U) The final six transport profiles [B-2(m) and B-2(t] are for local area networks (LANs):[3]

- T.611, CSMA/CD LAN with CONS
- T.612, Token Bus LAN with CONS
- T.613, Token Ring LAN with CONS
- T.6211, CSMA/CD LAN, CLNS Single-LAN Environment
- T.6212, CSMA/CD LAN, CLNS Multiple-LAN Environment
- T.622, Token Bus, CLNS Multiple-LAN Environment
- T.6231, Token Ring LAN, CLNS Single-LAN Environment
- T.6232, Token Ring LAN, CLNS Multiple-LAN Environment.

4. RELAY PROFILES

(U) Figure B-2 identifies 11 relay profiles. These are:

- Relaying the CONS:[4]
  - R.11, LAN to LAN
  - R.12, LAN to X.25 (PSDN)
- Relaying the CLNS:
  - R.21, LAN to LAN
  - R.22, LAN to X.25 (PSDN)
- Relaying the X.25 Packet Layer Protocol:
  - R.31, LAN to LAN
  - R.32, LAN to X.25 (PSDN, Virtual Call)
  - R.33, X.25 (PSDN, Virtual Call) to X.25 (PSDN, Virtual Call)

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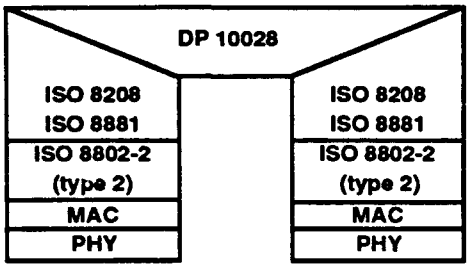
2 (U) All the T-profiles provide the Connection-Oriented Transport Service (COTS). U-profiles would use the Connectionless Transport Services (CLTS)--no U-profiles have been identified in the 1989 *NTIS Transition Strategy*.

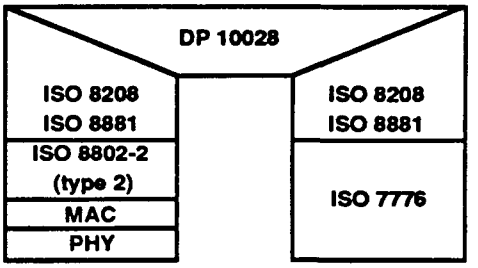
3 (U) No T-profiles are given in the 1989 *NTIS Transition Strategy* for T.614, Fiber Distributed Data Interface (FDDI) LAN with CONS or for T.624, FDDI LAN with CLNS.

4 (U) The 1989 *NTIS Transition Strategy* also identifies (without specifying the protocol stacks) a military profile being developed in SG9 WG1 for R.131(M), Relaying the CONS, WAN/PSDN to WAN/PSDN Using X.75.

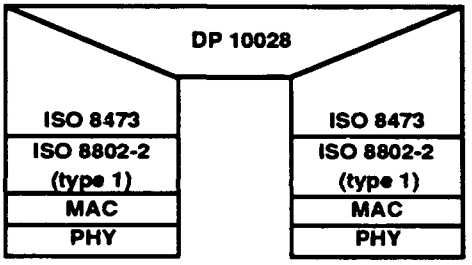
- Relaying the Media Access Control (MAC) Service:
  - R.41, CSMA/CD to CSMA/CD
  - R.42, CSMA/CD to Token Ring
  - R.43, Token Ring to Token Ring
  - R.44, CSMA/CD to Fiber Distributed Data Interface (FDDI)



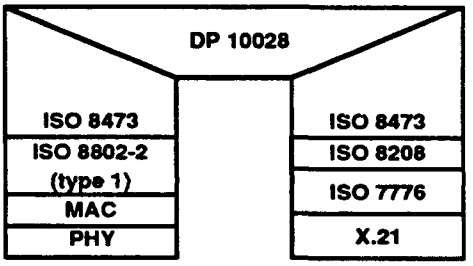
(a) R.11, Relaying the CONS, LAN-LAN



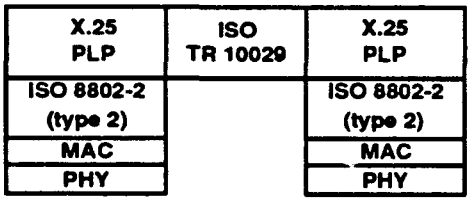
(b) R.12, Relaying the CONS, LAN-X.25 (PSDN)



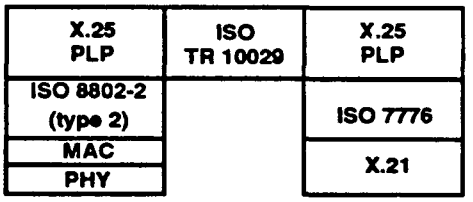
(c) R.21, Relaying the CLNS, LAN-LAN



(d) R.22, Relaying the CLNS, LAN-X.25 (PSDN)



(e) R.31, Relaying the X.25 Packet Layer Protocol, LAN-LAN



(f) R.32, Relaying the X.25 Packet Layer Protocol, LAN-X.25 (PSDN, Virtual Call)

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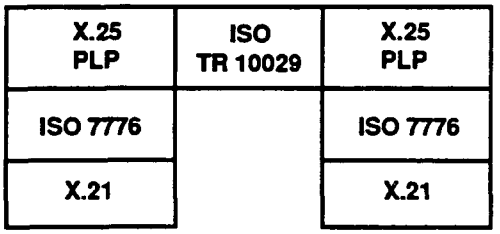
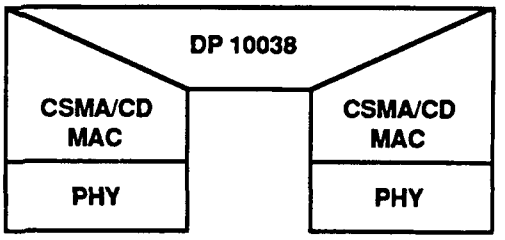
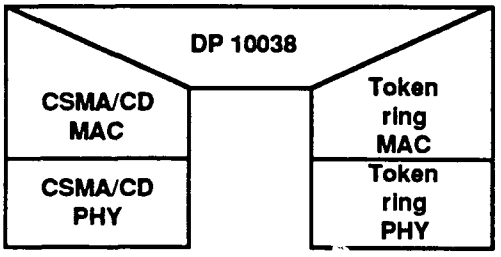
Figure B-3. (U) Relay Functional Profiles



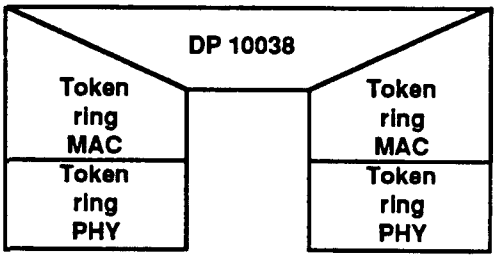
(g) R.33, Relaying the X.25 PLP, X.25 (PSDN Virtual Call)-(PSDN, Virtual Call)



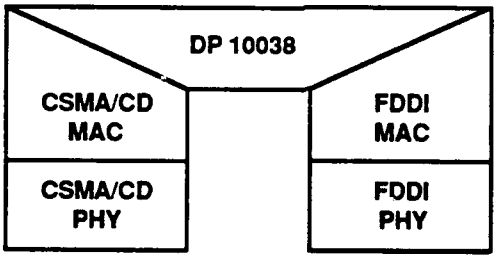
(h) R.41, Relaying the MAC Service, CSMA/CD-CSMA/CD



(i) R.42, Relaying the MAC Service, CSMA/CD-Token Ring



(j) R.43, Relaying the MAC Service, Token Ring-Token Ring



(k) R.44, Relaying the MAC Service, CSMA/CD-FDDI

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Figure B-3. (U) Relay Functional Profiles (Continued)

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APPENDIX C

NATIONAL INITIATIVES FOR MILITARY USE OF OSI STANDARDS

NATIONAL INITIATIVES FOR MILITARY USE OF OSI STANDARDS

1. INTRODUCTION

1.1 General

(U) This appendix identifies national initiatives that make or plan to make significant use of OSI standards in military applications. Major bilateral and multilateral initiatives are discussed in the main body of this working paper; these include the Quadrilateral Interoperability Programme (Section 9.3.5) and STAMINA (9.3 6).

1.2 Purpose

(U) The primary purpose of this review of national initiatives is to identify the ways in which military features are being addressed in national systems. In some cases, there may be fully compliant use of OSI standards. In other cases, there may be defined some extensions to the standards that could be considered by international bodies as candidates for new options to the commercial standards, so that in the time frame of ATCCIS (and other NATO CCIS projects) the military features (e.g., a secure local area network) may be specified by civil standards. On the other hand, analysis of national initiatives may lead to conclusions that some features may need to be specified as deviations from civil standards and, in these cases, the relevant STANAGs may need to have similar deviations.

1.3 Scope and Organization

(U) National initiatives discussed in Section 2 are addressed, where possible, in terms of requirements, profiles, and transition strategies that have been recommended or adopted. A short review is provided in Section 3 of work being done to evaluate the performance of civil standards for military applications. Several initiatives that have led to fielded operational capabilities are discussed in Section 4 in some detail.

2. OVERVIEW OF NATIONAL INITIATIVES TO IMPLEMENT OSI STANDARDS IN MILITARY AND RELATED SYSTEMS

2.1 France

Army Tactical CCIS Systems (U). Army tactical CCIS systems in France are using or are projecting to use more and more components based on OSI standards. The Army is following the general recommendations of standards organizations such as AFNOR, SPAG, CCITT, and CEN/CENELEC (see Appendix F), and would thereby try to use, wherever possible, the products (hardware and software) built upon these standards.

(U) One example of the implementation of OSI standards in Army tactical systems is the use of ETHERNET™ (ISO 8802.3) to link cells within a command post. In addition, tactical networks, such as RITTER and RETINAT, are based on CCITT X.25 packet switched standards. Table C-1 identifies the international OSI standards that the Army intends to use in its standardized MHS Gateway, based on QTIDP specification.

Table C-1. (U) French Army Standardized MHS Gateway

UNCLASSIFIED

OSI Layer	International Standard	Brief Title of Standard
Application (Layer 7)	CCITT X.400 ISO 9066-2 ISO 8649, 8650	MHS RTSE ACSE
Presentation (Layer 6)	CCITT X.409	Abstract Syntax Notation
Session (Layer 5)	ISO 8326, 8327	Basic Service and Protocol
Transport (Layer 4)	ISO 8072, 8073	Class 2 Service and Protocol
Network (Layer 3)	ISO 8208	Basic Service and Protocol
Data Link (Layer 2)	ISO 7776	HDLC LAP B
Physical (Layer 1)	CCITT X.21	

RETINAT (U). RETINAT is a data communications systems for the French Army. The network operates 33 switches of two types (one for military districts and one for military regions). The network accommodates 1,400 synchronous and 600 asynchronous ports and supports data rates from 300 bps to 64 Kbps. The switches are interconnected with 64-Kbps truncks and use X.75 gateways for interoperability with other data networks.[1]

Real Time Transport Service (RTTS) (U). The French MOD has developed an architecture and implementations of that architecture for a Real Time Transport Service (RTTS). GAM-T-103 is a specification for an implementation of this architecture.[2] RTTS results from more than 15 hears of experience in the design and realization of real-time data networks for military systems. RTTS provides not only data communication services but also synchronization and management services. RTTS was described at the June 1990 Military OSI Symposium at STC.[3] The paper addressed the ISO Transport Service, real-time constraints, and a proposed real-time Transport Service. It presented the classes of service, the models used for data transfer, the connection-oriented and connectionless modes for communication services, the synchronization services, and the management services. RTTS has been proposed in draft STANAG 4254 (Annex E) as the basis for defining real-time services for NATO CCISs (see Section 10.4.4).

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1 (U) *Secure Data Communication Defence System*, Vincenzo Cassese, ALCATEL CIT, France, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

2 (U) *Military Real Time Local Area Network*, GAM-T-103, Ministre de la Defense, Republique Francaise, 9 February 1987, UNCLASSIFIED.

3 (U) *Definition of Real-Time Services for the OSI Transport Layer*, Pascal Prophete, STEI, French MOD, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

Public Message System (U). ATLAS 400 is a public messaging system based on CCITT MHS X.400-1984 and is a good illustration of the national implementation of X.400 standards. Administration and design of ATLAS 400 is under the responsibility of TRANSPAC, a public company that is a subsidiary of FRANCE TELECOM. The ATLAS 400 services can be provided to private companies or administrations, and different kinds of systems can be built:

- A large company can get its own "private" messaging system, and all the nodes can be split throughout the country at the different company's locations.
- It is also possible to get a system that allows different organizations (public or private) to exchange messages between them. This can be useful, for example, to exchange documents between provider and client. Such an implementation would be used to exchange information between different companies.

(U) The ATLAS 400 functional profile is defined in *Specification Technique d'Utilisation et de Raccordement (STUR) ATLAS 400,* which defines Layers 1 to 7. This document also derives from an early effort of the Centre National d'Etude des Telecommunications (CNET) to promote the X-Series standardization (this work, named ARCHITEL, is described below).

(U) ATLAS 400 is only an interpersonal messaging system, and so uses only the Interpersonal Messaging Protocol from the X.400 Series. ATLAS 400 can also be adapted to the size of the company's computer equipment. For example, the Message Transfer Agent may be locally implemented or derived from the ATLAS 400 implementation. Thus, the User Agent and the Message Transfer Agent are not necessarily co-resident. This illustrates the possibilities of tailoring the system to client use.

ARCHITEL (U). Historically, ARCHITEL is a group effort within CNET. Its purpose was to promote the use of X-Series standards for the widespread use of FRANCE TELECOM and telecommunications companies, in particular by the CNET contractors. ARCHITEL defined X-Series profiles in the early 1980s. ARCHITEL implemented these profiles, specifically those for the lower five layers, to validate the parameters and options used for interoperation and also to clarify the standards where necessary. In some cases, ARCHITEL identified and developed recommendations to address portions of the standards that were judged to be imprecise. The profiles defined in ARCHITEL specified Class 0 and Class 2 for the Transport Layer and the connection-oriented network service for CCITT X.25. (X.25 is used in the public packet switched network, TRANSPAC.)

(U) The ARCHITEL profile is a complete specification that precludes at Layer 3 such capabilities as adding user data to a packet call, using nonstandard packet sizes, etc. All the parameters and options for each layer needed to ensure interoperation are addressed.

(U) ARCHITEL has published the reference document, *STUR ARCHITEL,* which states all the functional profiles for the lower five layers of the CCITT OSI Reference Model (e.g., X.215 and X.225 for the Session Layer). STUR ARCHITEL is informative, not mandatory. It was one of the earliest functional profile descriptions for the industrial community and was therefore instrumental in providing proof of concept of the use of OSI standards on a national scale. Thus, historically, STUR ARCHITEL was the basis for the development for OSI implementations now in use by the military. The military implementations have also included Transport Class 3.

2.2 Netherlands, Norway, France, United Kingdom

(U) Four NATO nations are participating in a project entitled "Cooperative Prefeasibility Studies for Tactical Communications Systems for the Land Combat Zone--Post 2000." In this study, candidate subsystem architectures are being developed on the basis of current and near future communications technologies as ISDN, EUROCOM, FDDI, PABX, packet radio and cellular telephony. From these technologies six subsystem architecture alternatives were derived each with either a nodal (centralized) or a nodeless (distributed) characteristic.

(U) From this set, subsystem architectures are selected on the basis of military operational requirements and threat expectations to form one system architecture for the entire Land Combat Zone. The chosen system architecture to cover the intermediate and the rear zone of the land combat zone. The wide

area communications subsystem consists of a backbone of distributed Local Area Communications Subsystem (LACS) elements with centralized LACS elements providing access to the backbone.[4]

2.3 United Kingdom

Robust Protocols Research Programme (U). The UK MOD and NATO has established the Robust Protocols Research Programme at RSRE to quantify and minimize the risks associated with the UK MOD and NATO policies for procuring future CCISs to ISO OSI standards. The approach being taken is to take commercial off-the-shelf protocols that are as near as possible to the perceived military requirement. The performance of these protocols is being established under ideal and degraded conditions in the laboratory.

(U) Initial work has concentrated on the X.400 and FTAM standards. A protocol stack, using X.400 or FTAM, Transport Service Class 4 (TP4), and connectionless network service (CLNS) over X.25(1984) has been selected. These were selected to give a worst case scenario for evaluating the protocol standards. Early results have provided an upper bound to the overheads that may be experienced under ideal conditions. This result will be used for the design and sizing of messaging networks. Some measurements on the performance of FTAM over degraded links have also been obtained. These have shown how a more "intelligent" implementation of the data link protocol could provide optimum throughput over a range of degraded conditions.[5]

Defense Fixed Telecommunications System (DFTS) (U). MOD central Defense staffs are establishing a Defense Packet Switched Network (DPSN). This project is a major element of a wider Defense-wide communications infrastructure covering all communications services: the Defense Fixed Telecommunications System (DFTS). Over time, the present MOD and Armed Forces communications systems will integrate to DFTS. Profiles that have been recommended for the DFTS are of three types: end-system services, common application services, and basic communications services. End-system services, together with the proposed standards, are electronic trading (based on EDI), revisable document exchange (based on ODA), general file transfer (based on FTAM), remote terminal access (based on VT), inter-personal messaging (based on MMHS), and inter-organizational messaging (also based on MMHS). Common application services include message handling (MMHS), Directory, ACP 127 interworking (MMHS), shared file store (FTAM), and shared database (RDA and SQL). The basic communications service profiles are T.31(M) for WAN access, T/611 and T/613 for LAN access, R.131(M) for WAN-to-WAN relay, and R/21 for LAN-to-LAN relay.[6]

(U) The UK MOD has a commitment to provide its Single Service strategic communications needs via a common communication network (DFTS). It is also MOD policy that such provision should, to the greatest extent possible, be procured from the civil market to standards recognized by the international community. Progress in implementing the DFTS has been slow as the priority of each of the Single Services has been to deploy their own systems, leaving convergence to DFTS until a later date. However, one subset of DFTS, the packet switched data communications network (DPSN), was identified as requiring common provision to satisfy immediate operational needs.

(U) The DPSN procurement has been guided by the DFTS Architecture and Procurement Working Group (DAPWG), which recommended that (1) the network be based upon the internationally

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4 (U) *Post 2000 Communications Architectures*, A. T. A. M. van de Voort, TNO Physics and Electronics Laboratory, Netherlands, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

5 (U) *Practical Evaluation of OSI Protocols*, J. Price, D.B. Hearn, J. Laws, A.F. Martin, and J. Staromlynska, RSRE, UK MOD, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

6 (U) *MOD(UK) Plans for OSI: Civil Section Relationship*, M. A. Bailey, MOD(UK) Directorate General of Information Technology Systems (DGITS), Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

recognized X.25 standard for network access; and (2) potential candidate network systems should be mature, have considerable expansion capability, and be supported by a manufacturer with a total commitment to the product and development of the relevant standards. The procurement has been distinguished by the short time scale between statement of requirement and in-service operation, and being both within the financial provision and satisfying the operational requirement. For the future some significant issues have to be developed and resolved, not the least being interworking with other systems, e.g., ISDN, multilevel security and management across the boundary between DPSN and end-user systems.[7]

2.4 United States

DoD Transition to GOSIP (U). The US DoD intends to adopt OSI protocols as a full co-standard with DoD protocols, specifically for message handling and file transfer (MIL-STDs 1777, 1778, 1780, and 1781). In 1990, 2 years after US GOSIP was approved as a federal standard, "OSI protocols will become the sole mandatory interoperable protocol suite."[8] The Defense Communications Agency (DCA) has been named as the DoD Executive Agent for Data Communications Protocol Standards, and in June 1988 this agency promulgated an OSI implementation strategy.[9] The Services and Agencies have developed transition plans to comply with this strategy.

Packet Switching for DDN (U). The US Defense Communications Agency has implemented an X.25 packet-switched protocol for the Defense Data Network (DDN). This protocol includes the use of the US DoD-unique protocols for Layers 3 and 4, namely the Internet Protocol (IP) and the Transmission Control Protocol (TCP). DDN supports over 50,000 users of a DoD-unique electronic mail (E-Mail). DDN contains a set of physically, procedurally, and cryptographically secured packet switching segments for classified E-Mail in the Defense Integrated Secure Network (DISNET) (e.g., DISNET-1, DISNET-2, DISNET-3). There are additional segments for unclassified E-Mail [e.g., Military Network (MILNET) and Advanced Research Projects Agency Network (ARPANET)]. Local area networks (LANs) are connected to the DDN by gateways or hosts using the DoD IP.

Defense Message System (DMS)--Upgrades for DDN (U). The US has initiated[10,11] a project called the Defense Message System (DMS) that will eventually integrate DDN with the Automatic Digital Network (AUTODIN). DMS will phase in[12] such protocols and services as US GOSIP, CCITT X.400 Message Handling System, High-Level Data Link Control (HDLC) for subscribers, new asynchronous protocol(s) with reliable transfer for subscribers, and CCITT X.500 Directory Services. TCP/IP protocols will be phased out. Initially (Phase I) a US DoD-unique security program called BLACKER will be implemented at the host-to-host level, which will ultimately result in an integrated DISNET. Later (1993) DDN will consist of MILNET (unclassified) segments and DISNET (classified) segments connected by BLACKER-protected gateways.

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7 (U) *UK Defence Packet Switched Network (DPSN)*, Alan Dibble, DSLC, and John Laws, RSRE, UK MOD, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED

8 (U) *Memorandum on Open Systems Interconnection Protocols*, ASD(C3I), 2 July 1987, UNCLASSIFIED.

9 (U) *The Department of Defense Open Systems Interconnection (OSI) Implementation Strategy*, Defense Communications System Organization, DCA, May 1988 (promulgated 17 June 1988), UNCLASSIFIED.

10 (U) Briefing to the US Postcoordination Meeting for TSGCEE SG9 on Defense Message System, DCA, 21 March 1989, UNCLASSIFIED.

11 (U) *Implementation of Multicommand Required Operational Capability (MROC) 3-88, The Defense Mapping System (DMS)*, Director for C3 Systems, Joint Staff, 6 February 1989, UNCLASSIFIED.

12 (U) *Defense Message System (DMS) Target Architecture and Implementation Strategy (TAIS)*, DCA, December 1988, UNCLASSIFIED.

US Army Initiatives (U). The US Army has a number of initiatives underway that address tactical implementations of OSI standards. The initiatives are under the direction of the Interoperability and Standards Directorate of the Communications-Electronics Command. The Army has an initiative to evaluate OSI protocols (including possible enhancements) in the newly developed Single-Channel Ground/Air Radio System (SINCGARS) combat net radio (VHF-FM). Specifically, the Army is examining options to provide an automatic voice/data contention resolution protocol at the Medium Access Control (MAC) sublayer of the data link layer (Layer 2). Some investigation of a forward error correcting Layer 2 protocol is also ongoing. In addition, an OSI profile is being developed for a local area network (T.LAN). Further, the Army has procured with its Common Hardware and Software (CHS) nondevelopmental item (NDI) program a number of commercial OSI implementations, including ISO 8802.2 and 8802.3 for the local area network (TCP/IP and other DoD protocols will be used initially at layers above Layer 2). CHS has CCITT X.25 switched protocols for wide area networks (these also are used in conjunction with TCP/IP). Finally, the CHS has a standard graphics interface and plans in the next procurement phase to obtain, if possible, a POSIX-conformant operating system.[13]

US Marine Corps Initiatives (U). The Marine Corps has adopted a Technical Interface Design Plan (TIDP) for Marine Tactical Systems (MTS)[14] that mandates the use of bit-oriented messages and two functional profiles for protocols in all its command and control systems. One profile for broadcast mode is designed to be used in combat net radio. It has been implemented in the AN/PSC-2 Digital Communications Terminal (DCT). The second profile of protocols is for switched mode and was developed from the Joint Tactical Communications Program (TRI-TAC) Interface Control Documents. This profile has been implemented with the Unit Level Tactical Data Switch (ULTDS). The switched profile is also being implemented with the Tactical Air Operations Module (TAOM) and a developmental system for air operations--Advanced Tactical Command and Control Center (ATACC). Although not fully OSI conformant, the two MTS profiles are based on several OSI standards (ISO 3309, ISO 7809, and ISO 4335). The Marine Corps' approach to data communications standards and profiles follows the OSI seven-layer model and incorporates military features not covered within the ISO standards.

DoD Protocol Suite (U). Figure C-1 shows the DoD protocol suite.[15] The upper layer protocols providing user functionality support file transfer [File Transfer Protocol (FTP),[16] MIL-STD-1780]; electronic mail [Simple Mail Transfer Protocol (SMTP), MIL-STD-1781]; and remote system access [TELNET Protocol,[17] MIL-STD-1782]. The middle layers provide a reliable host-to-host transport protocol [Transmission Control Protocol (TCP) MIL-STD-1778] on top of a connectionless (CL) internetworking protocol [Internet Protocol (IP), MIL-STD-1777].

(U) No lower layer protocols are specified in the DoD protocol suite--it uses whatever protocols are required to access the network to which it is attached. Thus, for example, the DoD protocol suite uses the Ethernet™ (ISO 8802.3 CSMA/CD Media Access Control for a coaxial cable 10-Mbps LAN) protocol to operate of a local area network and the DDN implementation[18] of the CCITT X.25

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13 (U) Discussions with staff from the Information Systems Directorate, CECOM, March 1989, UNCLASSIFIED.

14 (U) *Technical Interface Design Plan for Marine Tactical Systems (MTS TIDP)*, Volume V, *Protocol Standard*, Headquarters, US Marine Corps, July 1987, UNCLASSIFIED.

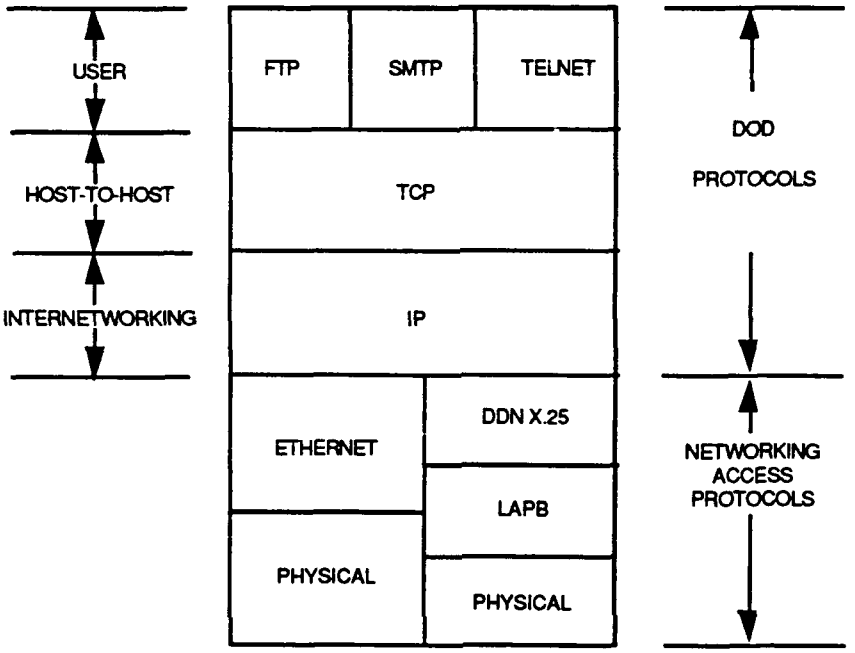
15 (U) The figures and information for this section and the following sections on US GOSIP and proposed mixed stacks for Army CCISs is taken from *Use of OSI Protocols for US Army Tactical Command and Control Applications*, Richard Nieporent and Brajesh Mishra, The Mitre Corporation, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

16 (U) FTP provides a simple application for transfer of ASCII, EBCDIC, and binary files.

17 (U) TELNET Protocol provides a simple scroll-mode terminal capability.

18 (U) The DDN implementation of X.25 was provided by Bolt Beranek and Newman. It is also planned for use in the Mobile Subscriber Element (MSE) for Army area communications.

protocol (X.25 Packet Level Protocol, ISO 8208) and the HDLC LAPB (ISO 7776) procedures to operate over a wide area packet switching network. Although DoD protocols are not international standards, they have become a de facto open standard in the US--almost every vendor provides the DoD protocols in their version of the UNIX operating system. The DoD protocols are also included in the ATCCS Common Hardware and Software (CHS) procurement and are specified for use over the CHS IEEE 802.3 (ISO 8802.3) tactical LAN. Finally, the DoD protocols are used by the MSE packet switched network (PSN).



UNCLASSIFIED

Figure C-1. (U) DoD Protocol Suite

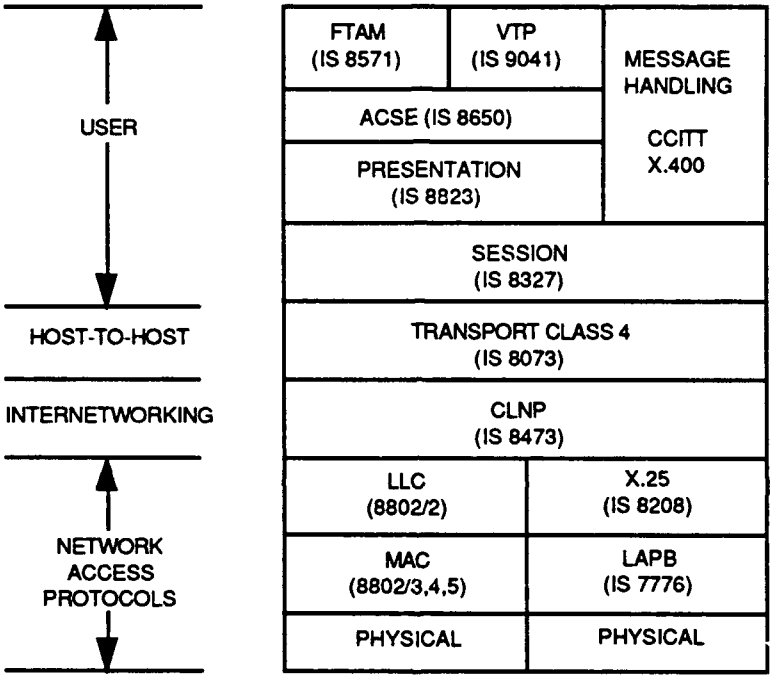
(U) The DoD protocol suite has two drawbacks for their use in tactical CCISs:

- They are not US GOSIP compliant. It would be necessary for implementations of the DoD Protocols to undergo an expensive and time-consuming transition to satisfy the GOSIP mandate. In particular, the battlefield functional area (BFA) applications will have to be modified to use the functionality of the GOSIP protocols.
- GOSIP Application Layer protocols provide more functionality than the DoD protocols. Moreover, more effort is now being committed by the nations for the OSI protocols than by the US in the DoD arena. As new OSI protocols are developed that meet tactical communication requirements, they are expected to be incorporated in GOSIP. Thus, future versions of GOSIP are expected to provide considerably more functionality than the DoD protocol suite.

Version 2 of US GOSIP (U). Figure C-2 shows the US GOSIP protocol suite as it will appear in Version 2 (planned to be mandated for use in August 1991). The applications supported are the same as the DoD protocols: file transfer (FTAM, ISO 8571), electronic mail (MHS, CCITT X.400-series

1984 recommendations;[19] and MOTIS, ISO 10021 and 9066], and the Virtual Terminal Protocol (VTP, ISO 9040 and 9041). Also, like the DoD protocol suite, a transport protocol (Transport Class 4, ISO 8073) is specified that will provide reliable host-to-host communications, and a CL network protocol (CLNP, ISO 8473) is specified for internetworking. Unlike the DoD protocols, US GOSIP provides for the Layer 7 Association Control Service Element (ACSE, ISO 8650), connection-oriented protocols for the Presentation Layer (ISO 8823, Layer 6), and connection-oriented protocols for the Session Layer (ISO 8327, Layer 5).

(U) However, unlike the DoD protocol suite, GOSIP explicitly specifies a number of network access protocols, including IEEE 802 (Logical Link Control, ISO 8802.2; CSMA/CD, ISO 8802.3; Token Bus, ISO 8802.4; and Token Ring, ISO 8802.5) for communications over a LAN and the X.25 protocol for wide area packet switch network communications.



UNCLASSIFIED

Figure C-2. (U) US GOSIP Protocol Suite, Version 2

(U) There is one major disadvantage to using GOSIP in Army CCISs now. The MSE PSN internetworking capability for tactical area communications can not be used with GOSIP, since GOSIP has a different internetworking protocol (CLNP) than the DoD protocol suite (IP). Access to the MSE PSN will still be possible using a direct interface to the tactical LAN.

Mixed Protocol Stacks for Future Army CCISs (U). The US Army is developing an automated Army Tactical Command and Control System (ATCCS) for the tactical battlefield. Communications connectivity for the ATCCIS will be provided by the US Army's local and wide area tactical communications networks. A protocol suite must be selected for the ATCCS that can interface to these tactical networks and support a wide range of tactical communications applications. A mixed protocol

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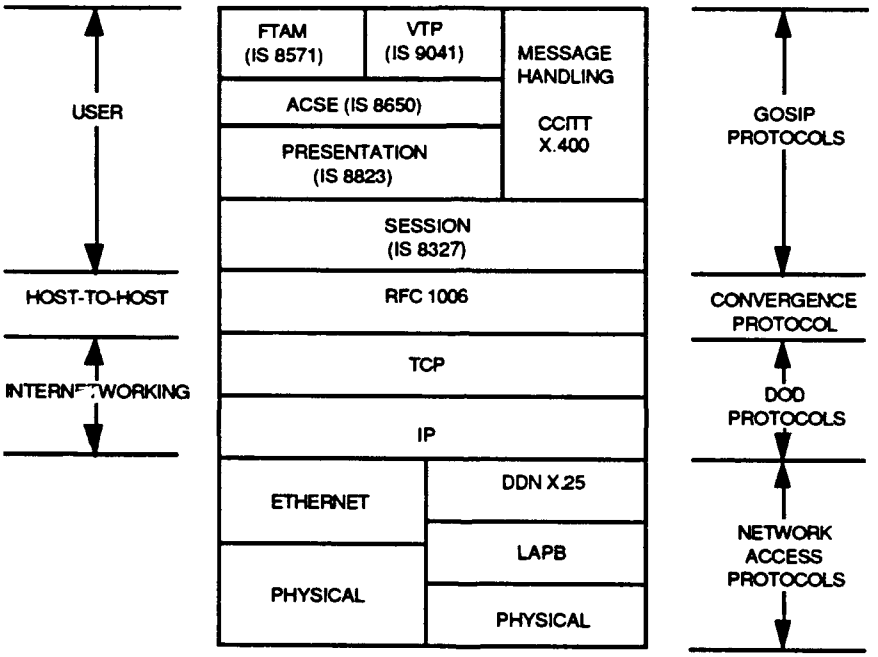
19 (U) US GOSIP 1.0 and 2.0 mandate use of X.400(MHS)-1984. US GOSIP 3.0 is expected to require X.400(MHS)-1988.

suite, consisting of OSI upper layer protocols operating of the US DoD transport and internetworking protocols (TCP/IP), has been recommended to support the required ATCCS functionality and interoperability and provide a direct migration path to US GOSIP and the NATO militarized OSI protocols.

(U) Figure C-3 shows a proposed mixed suite of protocols for ATCCS. The upper three layers consists of the GOSIP Session, Presentation, and Application Layers. The same FTAM, X.400, and VTP Application Layer protocols are specified as in GOSIP. The middle protocol layers are the same as in the DoD protocol suite: TCP and IP. Also, as in the DoD protocol suite, the lower layer protocols (Physical, Data Link, and Network Layers) are unspecified.

(U) A Convergence Protocol [Request for Comment (RFC) 1006, *ISO Transport Service on Top of the TCP*, Version 3, 1987] is needed to interface the GOSIP upper layer protocols to the DoD internetworking protocols. The Convergence Protocol provides OSI Transport Class 0 (TP0) along with a packetization protocol.[20] This protocol is commercially available in Version 6.0 of the ISO Development Environment (ISODE).



UNCLASSIFIED

Figure C-3. (U) Proposed Mixed Protocol Suite

(U) The mixed protocol suite has the increased functionality of the GOSIP Application Layer protocols, without sacrificing compatibility with the MSE PSN. No changes will be necessary in BFA applications, when ATCCS transitions to GOSIP, since they would already use the GOSIP Application Layer protocols.[21]

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20 (U) Since TCP is a stream-oriented protocol and TP0 is a block-oriented protocol, the packetization protocol is needed to preserve the OSI packet boundaries.

21 (U) *Use of OSI Protocols for US Army Tactical Command and Control Applications*, Richard Nieporent and Brajesh Mishra, The Mitre Corporation, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

3. IDENTIFICATION OF EFFORTS TO EVALUATE THE PERFORMANCE OF CIVIL STANDARDS FOR MILITARY USE

3.1 Introduction

(U) This section identifies a number of papers submitted in June 1990 to the Military OSI Symposium at SHAPE Technical Centre that describes analytical and demonstration efforts to evaluate the performance of OSI and other protocols for use in military systems. These papers should be consulted for detailed results.

3.2 Sources of Reports on Performance Evaluations

(U) *Practical Evaluation of OSI Protocols.* This paper summarizes work being done under the Robust Protocols Research Programme at the Royal Signals and Radar Establishment (RSRE) in the UK MOD. As noted in Section 2.3, the work has concentrated on X.400 and FTAM over TP4, CLNS, and X.25.[22]

(U) *User Performance of Tactical Networks in the ITDN.* User performance experiments were conducted in 1989 on portions of the Integrated Tactical-Strategic Data Network (ITDN) Demonstration that simulated tactical areas at echelons corps and below. The performance of four tactical links [Fleet Satellite Communications (FLTSATCOM), MSE line-of-sight radio, Tactical Satellite (TACSATCOM), and Very Small Aperture Terminal (VSAT)] was measured at the protocol level that most directly affects the network user. The results, though preliminary, can help predict the performance of applications in tactical nets. US DoD protocols were measured; however, the results may provide the basis for informed conjectures about the user-level performance of OSI protocols.[23]

(U) *Transport Protocols and Internetworking in Low Bandwidth Tactical Networks.* This paper examines the impact of packet size on end-to-end functionality (including reliable delivery, packet resequencing, segmentation, and flow control). Tradeoffs between a small packet size required because of the unreliable media and a large packet size required to minimize the header overhead are considered using standard transport protocols. The choice of ULP depends on the application required to run over the network; for instance, military messaging application could use X.400 and its supporting presentation and session layers as specified in US GOSIP or the enhanced versions proposed in STANAGs 4265-4269. The paper also assess the impact of the transport protocol selection on the network architecture in an internetwork configuration.[24]

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22 (U) *Practical Evaluation of OSI Protocols*, J. Price, D.B. Hearn, J. Laws, A.F. Martin, and J. Staromlynska, RSRE, UK MOD, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

23 (U) *User Performance of Tactical Networks in the ITDN*, Gladys Reichlen and Allison Mankin, The Mitre Corporation, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

24 (U) *Transport Protocols and Internetworking in Low Bandwidth Tactical Networks*, Shiraz G. Bhanji, The Mitre Corporation, Proceedings of the SHAPE Technical Centre Military OSI Symposium, 6-8 June 1990, NATO UNCLASSIFIED.

4. DETAILED REVIEW OF SELECTED NATIONAL INITIATIVES

4.1 Example of a Broadcast Profile for Data Communications Using Tactical Radios

(U) This section uses the OSI Reference Model and interoperability parameters to identify interpretations, extensions, and deviations to OSI and other standards in the specification of a set of protocols used to support data transmission over combat net radio by the US Marine Corps. These protocols are specified in Volume V of the Marine Corps MTS TIDP.

(U) The MTS protocols were developed based on US federal standards in the late 1970s. Many of the standards selected have become ISO standards, and the structure of the MTS protocols can be interpreted in terms of the seven-layer OSI Reference Model. The MTS broadcast profile, discussed in this section, is now being used by the Army and the Marine Corps as the basis for defining the initial protocol standards to be used in the TIDP now being developed for Joint Interoperability of Tactical Command and Control Systems (JINTACCS) K-Series Variable Message Format (VMF) bit-oriented messages. The K-Series messages and associated data communications protocols are being specified by the joint Fire Support Subgroup (FSSG) of the JTIDS Message Standards Working Group (JMSWG) under the auspices of the Joint Tactical C3 Agency.

(U) Table C-2 highlights the features provided in the broadcast protocol, used in Marine Corps tactical data systems (TDSs), for each of the seven layers. It further identifies the standards used in each layer and notes the interpretations, exceptions, extensions, and deviations that were specified.

(U) Military features supported by the broadcast protocol standard and identified in Table C-2 include:

- Multiaddressing (Layer 7, through the Message Header; and Layer 2, through the extended address field)
- Data integrity and, more generally, the capability to operate in a high bit-error-rate environment [Layer 2, through use of a 32-bit frame check sequence (FCS) for error checking and the (23,12) half-rate Golay error detection and correction coding (ED&C), together with 16x24-bit interleaving]
- Use of XID command and response (Layer 2)
- Control of emanations by senders and recipients through provisions for optional acknowledgements (ACKs) (Layer 7--request for ACK is part of the message) and for not sending ACKs even when requested (Layer 2), both under operator control
- Limit on the number of retransmissions permitted (Layer 2)
- Providing for net access (uses an international standard in Layer 2 for handling media access contention and collision detection[25] and defines an algorithm for wait times for reattempting access); net access algorithms could be extended to support precedence and preemption.

4.2 Example of a "Datagram" Switched Protocol Standard for Tactical Radios

(U) This section summarizes a set of protocols used to support data transmission through tactical data switches by the US Marine Corps. These are the MTS switched protocols that are specified in Volume V of the Marine Corps *Technical Interface Design Plan for Marine Tactical Systems*.

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25 (U) The listen-before-talk contention method is called Carrier Sense Multiple Access with Collision Detection (CSMA/CD); this method has become an international standard for local area networks (ISO 8802.3).

(U) Table C-3 highlights the features provided in the switched MTS protocol for each of the seven layers. The table identifies the international and US standards used in each layer, and notes the interpretations, exceptions, extensions, and deviations that are specified.

4.3 Details of Standards for French National Initiatives for Enhanced Interoperability

(U) The Army will use standardized products based on the following standards:

- Programming language: LTR3 (Language Temps Reel), Ada, C
- Database: Relational database management systems, SQL
- Operating System: UNIX
- Development methods: Based on the French military standard GAM-T-17.

Table C-2. (U) A Functional Profile of Broadcast Protocols Used in Tactical Systems by the US Marine Corps

UNCLASSIFIED

ISO Layer, Function		Standards Cited	Notes on Interoperability Parameters
7	Msg Header Msg Acknowledgment	None None	Supports multiple addresses, precedence, and security classification.
6	Msg Format Information Field Size	None None	Maximum message length is 3500 octets.
5	None	N/A	Null layer.
4	None	N/A	Null layer.
3	Message Segmenting	N/A	Messages are not segmented.
2	Frame Formatting	ISO 3309/7809 (HDLC) with Options 7 and 14	Opt 7=Extended Address Field; 2-17 octets (base std is one octet; Opt 7 specifies no maximum on extended address field size). Opt 14=32-bit frame check seq (FCS) (base standard is 16-bit FCS).
	Frame Addressing	ISO 3309	
	Commands & Responses	ISO 4335/7809 with Option 1	Opt 1=XID. Does not support S&BM, DISC cmds and FRMR,UA,DM resp (radio application). Does not support P/F bit.
	Media Access	No standard applies	Uses CSMA/CD with unique algorithms for reattempting access to net.
	Data Link Initialization and Release	ISO 4335/7809 with Option 1 (XID)	XID is used during net establishment.
	Frame Transfer	ISO 4335/7809	Uses all 3 types of frames.
	Acknowledgment (ACK)	ISO 4335	ACK is optional; when invoked, it follows the standard.
	Retransmission	Not controlled by standards	Max 2 retries (under operator control) (no provision for setting a max in stds). Standards suggest use of P/F bit to control retransmission.
	ED&C--Error Detection	IS 3309/7809 w Opt 14	32-bit FCS (algorithm is ISO 3309, Sec 3.6.3).
	ED&C--Error Coding	Not controlled by standards	(23,12) half-rate Golay; 24th bit is zero filled (detects 6/corrects 3 errors in each 24-bit codeword).
	ED&C--Interleaving	Not controlled by standards	16x24-bit time dispersive coding (TDC).

Table C-2. (U) (Continued)

UNCLASSIFIED

ISO Layer, Function		Standards Cited	Notes on Interoperability Parameters
1	--Electrical		
	--Voltage Levels	MIL-STD-188-114	[Similar to CCITT V.10/X.261
	--Load Impedance	MIL-STD-188C	
		MIL-STD-188/24(Prt2)	
		MIL-STD-188-141	
	Mechanical		
	--Connectors	MIL-STD-242G(Prt8)	
		MIL-P-55149	
	Cable Lengths	MIL-STD-242G(Prt8)	
	Functional (pin assign)	MIL-STD-242G(Prt8)	
	Procedural		
	--COMSEC Pre/Postamble		
	Frame Placement	DCT Spec	
	--Keytime Delay	DCT Spec	
	--Bit Synchronization	DCT Spec	
	--Transmission Synch	DCT Spec	
	--Clocking Ctrl & Timing	N/A	

References:

1. Technical Interface Design Plan for Marine Tactical Systems (MTS TIDP), Volume V, Protocol Standard, Headquarters, U.S.Marine Corps, July 1987, UNCLASSIFIED.

2. Discussions with Systems Integration Directorate, MCRDAC, and LOGICON/Eagle Technology, Inc., March 1989.

Table C-3. (U) A Functional Profile of "Datagram" Switched Protocols Used in Tactical Systems by the US Marine Corps

UNCLASSIFIED

ISO Layer, Function		Standards Cited	Notes on Interoperability Parameters
7	Msg Header Msg Acknowledgment	None [1] None	• Supports multiple addresses, precedence, and security classification.
6	Msg Format	None	• Uses the same flagging scheme as the syntax adopted for US JINTACCS K-Series messages
	Information Field Size	None	• Max is 40 segments, 260 octets per segment (message length)
5	None	N/A	• Null layer
4	End-End Sequence Control	None	• Transport layer accumulates and orders packets for users; uses 7 octets (vice 20-60 octets for TCP)
	End-End Congestion/ Flow Control	None found	• Connectionless-oriented layer, a variant of TP4
3	Network Routing/Switching	None found	• Connectionless-oriented with deterministic routing [2] • Supports "floating" host, using operator-initiated disconnect and reconnect, but requiring no change of address
	Message Segmenting	Not controlled by standards	• 260-octet maximum message segment
	Packet Addressing	None	• Uses unique 3-octet routing indicator and provides for multiple addressing for up to 16 destinations
	Packet Precedence	None	• Uses 3 classes of precedence (SysCom, Data1, Data2), in which military precedences (Y-Z-O-P-R) are handled as Data2
	Network FLow &	None found	• Traffic from subscribers can be limited on precedence; traffic in network is processed by packet precedence
	End-End Error Recovery (Message Accountability)	None	• Detects loss of message frames, with notificication for nonperishable messages
	Congestion Control Internetting	N/A	• Not supported
2	Frame Formatting	ISO 3309/7809 (HDLC) with Options 10 and 14 ANSI X3.66-1979 (ADCCP) (MIL188 TRI-TAC Mode VII)	• Opt 10 calls for extended control field (two octets) • U-frame is extended (two octets) [3] • Opt 14 calls for 32-bit FCS
	Frame Addressing	ISO 3309	• Station address varies [4]
	Commands & Responses	ISO 4335/7809 with addit'l Options 2,4,5,8,11 [5]	• SIM cmd may be initiated at both stations for link initialization • RIM response not implemented • Does not support poll-final (P/F) bit
	Media Access	N/A	• When established (initialized), full-duplex point-to-point link has no access contention
	Data Link Initialization and Release	ISO 4335/7809 ANSI X3.66-1979 (ADCCP) TRI-TAC ICD 16	• Addresses security through use of UI-frames [6]
	Frame Transfer	ISO 4335/7809	• Uses all 3 types of frames
	Acknowledgment (ACK)	ISO 4335	• ACK or NAK is required
	Retransmission	ISO 4335	• Maximum of 5 retries • Retransmission is automatic if no ACK [7]

Table C-3. (U) (Continued)

UNCLASSIFIED

ISO Layer, Function		Standards Cited	Notes on Interoperability Parameters
2	ED&C--Error Detection	IS 3309/7809 w Opt 14	• 32-bit FCS (algorithm is ISO 3309, Sec 3.6.3).
	ED&C--Error Coding	Not controlled by standards	• (23,12) half-rate Golay; 24th bit is zero filled (detects 6 and corrects 3 errors in 24 coded bits).
	ED&C--Interleaving	Not controlled by standards	• No time disperal coding (TDC)
1	Electrical		
	--Voltage Levels	MIL-STD-188-114	• [Similar to CCITT V.10/X.26]
	--Load Impedance	MIL-STD-188C MIL-STD-188/24(Prt 2)	
		TT-B1-4204-1101-001	• Conditioned di-phase signalling (TRI-TAC modem-like standard interface)
		MIL-STD-188-141	
	Mechanical		
	--Connectors	MIL-STD-242G(Prt 8)	
		MIL-P-55149	• For binding posts
	--Cable Lengths	MIL-STD-242G(Prt 8)	
	Functional (pin assign)	MIL-STD-242G(Prt 8)	
	Procedural		
	--COMSEC Pre/Postamble		
	Frame Placement	N/A	
	--Keytime Delay (sec)	N/A	• Varies [8]
	--Bit Synchronization	N/A	• 16 bits within keytime delay
	--Transmission Synch	TRI-TAC ICD (U.S.) [8]	• 32-bit transmission synch pattern; • 24-bit transm (16-bit) word count (Golay coded)
	--Clocking Ctrl & Timing	MIL-STD-188-100 (Para 4.3.1.6)	• 16 or 32 Kb/s switch rate

Notes:

1. Where there are standards, but none are cited for this protocol, "None" is used; where there are no applicable standards, "N/A" is used.

2. Profile establishes datagram services, not virtual circuits (CCITT X.25 Packet Layer Protocol is *connection oriented*).

3. U-frame format agrees with ANSI X3.66 but not with ISO 4335(1987) for extended control field regarding use of second octet. ANSI 3.66 requires a zero-filled (after the poll-final bit) second octet, but ISO 4335 has no extended control field for the U-frame.

4. For link-level frame addressing, TRI-TAC and ISO 3309 (Section 3.2) may be considered as consistent under the following interpretation: whenever one station sends a frame to the other station, the sender's link-level address is 10000000 and the recipient's link-level address is 11000000.

5. *ISO 7809 command/response options implemented: Opt 2--adds REJ cmd/resp; Opt 4--adds UI cmd/resp;* Opt 5--adds SIM cmd and RM resp [RM resp not implemented]; Opt 8 deletes I-frame for resp. CCITT X.25 LAP B is equivalent to HDLC Options 2, 8 and 10 (only)--this profile incorporates additional HDLC options not permitted by LAP B.

6. Link Initialization Parameter Notified (LIPN) is an application of the UI-frame that provides for six features: Congestion Control, Link Efficiency Control, Crypto ID Coordination of Security, Link Shutdown Notification, Emergency Shutdown Notification, and Orderly Shutdown Notification.

7. *Retransmission may be initiated by REJ, NAK, or time out waiting for an ACK.* ACK parameters not controlled by standards include: maximum retransmission attempts; and maximum transmissions outstanding without a response (allows for SATCOM delays). This profile allows 5 retransmissions and 18 transmissions outstanding without a response.

8. Keytime delay and transmission synchronization procedures depend on the link encryption hardware selected.

APPENDIX D

INTERNATIONAL STANDARDS RELEVANT TO ATCCIS

INTERNATIONAL CIVIL STANDARDS RELEVANT TO CCISs

I. OSI ARCHITECTURE AND GENERAL STANDARDS[1]

A. OSI BASIC REFERENCE MODEL AND CONVENTIONS:

STANAG 4250♦	NATO Reference Model for OSI Part 1--General Description, Revised Draft Part 2--Security, Draft (SANISI Document) Part 3--Naming and Addressing, Draft (Working Paper) Part 4--Management, Draft (Working Document) Part 5--Military Features, Draft (Working Document)
ISO[2] 7498-1♦	OSI Reference Model - Part 1: Basic Reference Model, General Aspects [SC21 N 3273] (CD text for revision incorporating AD1 expected November 1990)
	AD[3] 1♦ Connectionless-Mode Transmission
	PDAD[4] 2♦ Multipeer Data Transmission (MPDT)
	PDAD 3♦ Upper Layer Architecture (ULA)
ISO 7498-2♦	OSI Reference Model - Part 2: Security Architecture
ISO 7498-3♦	OSI Reference Model - Part 3: Naming and Addressing
ISO 7498-4♦	OSI Reference Model - Part 4: Management Framework
TR[5] 8509♦	Service Conventions
CD[6] xxxx-1	Conventions for Service Definitions - Part 1: General Model and Conventions (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supersede TR 8509)
CD xxxx-2	Conventions for Service Definitions - Part 2: Application Layer (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supersede TR 8509)
CD xxxx-3	Conventions for Service Definitions - Part 3: Layers 1-6 (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supersede TR 8509)

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1 The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

2 ISO: International Standard with final approval from ISO.

3 AD: Addendum for ISO standard.

4 PDAD: Proposed or Preliminary Draft Addendum to ISO standard.

5 TR: Technical Report for ISO.

6 CD: Committee Draft for ISO standard [formerly Draft Proposal (DP)].

DTR[7] 9575	OSI Routing Framework
CDTR[8] xxxx◆	Tutorial on Naming and Addressing, July 1990 [SC21 N 5102]
SC6 N 4782[9]	An Architectural Framework for Private Networks, Pre-Publication Version of ECMA TR 44, December 1987
SC21 SD-9[10]	Approved Commentaries on the Basic Reference Model for Open Systems Interconnection, SC21 OSI Reference Model Editor, 19 June 1990 [SC21 N 5217]
SC21 N 3207	Relationship Between Objects in Peer Open Systems, December 1988 [SC21/WG6]
SC21 N 3711	Requirements for Multipeer Data Transmission, July 1989
SC21 N 3906	Final Report to SC21 in Florence on the Reassessment of Project JTC 1.21.9.1 on Multipeer Data Transmission, October 1989
SC21 N 4240	Working Draft Addendum to ISO 7498 - General Aspects, December 1989
SC21 N 4546	Liaison Statement of SC21/WG1 on Update of the OSI Reference Model, CCITT SG VII, March 1990
SC21 N 4559	Liaison Statement to SC21 on OSI Reference Model Update Effort, CCITT SG VII, March 1990
SC21 N 4565	Liaison Statement to SC21/WG4/WG7 on Time Synchronization, CCITT SG VII, March 1990
SC21 N 4647	Requirements for Service Conventions, May 1990
SC21 N 4681	User Requirements for Multi-Party Communications (MPC), Canada, May 1990
SC21 N 4682	Establishment of User Requirements, Canada, May 1990
SC21 N 4763	On-Going Multipeer Projects Within JTC1, ANSI, May 1990
SC21 N 5017	Relationship Between Concepts and Models for OSI and ODP, SC21/WG6, July 1990
SC21 N 5073	Final Answer to Q1/30.5 on Definition of the Term "Quality of Service,", SC21/WG1, May 1990
SC21 N 5074	Final Answer to Q1/330.6 on Relay, Routing, and Network Management, SC21/WG1, May 1990
SC21 N 5081	Draft Answer to Q1/61 on Consistency Among ISO Standards Related to the OSI Reference Model, May 1990
SC21 N 5082	Call for Contributions on Protocol Profile Testing Methodology, Multi-Party Testing Methodology, TTCN Extensions, and Test Report Standardization, SC21/WG1, July 1990
SC21 N 5084	Liaison Statement to SC6 on OSI Conformance Issues, SC21/WG1, May 1990
SC21 N 5092	Revision of ISO 7498, Working Draft, SC21/WG1, July 1990
SC21 N 5093	Status and Method of Operation for the Reference Model Revision, SC21/WG1, May 1990
SC21 N 5095	Liaison to SC6 on Revision of the Reference Model, May 1990

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7 DTR: Draft Technical Report for ISO.

8 CDTR: Committee Draft Technical Report for ISO (formerly Proposed Draft Technical Report).

9 Selected working drafts (e.g., SC6 N 4782) have been included from ISO/IEC JTC1 Subcommittee (SC) 6, SC18, SC21, the Special Group on Functional Standardization (SGFS). These and other JTC1 standards organizations are discussed in Appendix F.

10 SD: Standing Document for ISO.

SC21 N 5096	Liaison to CCITT SG VII on Revision of the Reference Model, June 1990
SC21 N 5099	Liaison Statement to CCITT SG VII(Q.25) on Service Conventions, SC21/WG1, May 1990
SC21 N 5105	Final Answer to Q1/56.6.1 on Positioning of Circuit Switched Networks, SC21/WG1, May 1990
SC21 N 5109	Liaison Statement to CCITT SG VII(Q23) on Naming and Addressing, SC21/WG1, May 1990
SC21 N 5110	Call to National Bodies and Liaison Organizations for Contributions on Technical Structure of Quality of Service (QoS) Architecture, May 1990
SC21 N 5196	Report of the Special Meeting on User Requirements, SC21, 7 June 1990
SC21 N 5197	Report of the Standards Maintenance Group, SC21, 4 June 1990
CCITT X.200	Reference Model of OSI for CCITT Applications
CCITT X.210	OSI Layer Service Definition Conventions

B. WORK PLANS AND COORDINATION AGREEMENTS:

JTC1 N 535	Directives for the Work of ISO/IEC Joint Technical Committee 1 (JTC1) on Information Technology, Secretariat, 31 August 1989
JTC1 N 598	JTC1 Strategic Plan, Editing Team, 20 November 1989
SGFS[11] N 151	CCITT Liaison Statement on Work of SGFS, 6 November 1989 (includes X.220)
SC21 SD-1	Report of the Secretariat to the Plenary Meeting of ISO/IEC JTC1 SC21, 5-6 June 1990, Seoul, Republic of Korea, SC21 Secretariat, 12 April 1990 [SC21 N 4588] (provides terms of reference and points of contact for working groups)
SC21 SD-2	ISO/IEC JTC1 SC21 Programme of Work (POW) - Target Date Summary for All Active and Published Projects, SC21 Secretariat, April 1990
SC21 SD-8	Schedule of Meetings, SC21, 19 June 1990 [SC21 N 5216]
SC21 N 3122	Informal Guide for ISO/IEC JTC1 and CCITT Cooperation, 15 January 1989
SC21 N 3205	Proposed Modus Operandi and Programme of Work of SC21/WG6 ULA Rapporteur Group, December 1988 [SC21/WG6]
SC21 N 4758	Request to ISO/IEC SC21 from OSF for Establishment of Liaison Relationship, 4 May 1990
SC21 N 4801	Liaison Statement to SC21 on Joint Efforts Between SG VII(Q20) and SG I(Q16), CCITT SG I(Q.16), 21 May 1990
SC21 N 5071	Recommendations Approved by SC21/WG1 at its Seoul Meeting, 23-31 May 1990, SC21/WG1, May 1990
SC21 N 5072	List of Output Documents of SC21/WG1 Meeting, Seoul, 23-31 May 1990, SC21/WG1, July 1990
SC21 N 5131	Recommendations of the SC21/WG6 Meeting, 23 May - 1 June 1990, Seoul, SC21/WG6, June 1990
SC21 N 5136	Recommendations of SC21/WG3 Meeting in Seoul, May/June 1990, SC21/WG3, 19 June 1990
SC21 N 5154	Recommendations of the SC21/WG5 Meeting, Seoul, 24 May - 1 June 1990, SC21/WG5, June 1990

[11] SGFS: Special Group on Functional Standardization [develops International Standard Profiles (ISPs)].

SC21 N 5194	Resolutions of the Fourth Plenary Meeting of SC21, 5 June 1990, Seoul, SC21, 5 June 1990
SC21 N 5203	SC21/WG1 Convenor's Report to SC21 Plenary Meeting, Seoul, 5-6 June 1990, SC21/WG1, 3 June 1990
SC21 N 5219	Draft Management Guidelines for SC21, Rapporteur for Strategic Planning, July 1990

C. FORMAL DESCRIPTION TECHNIQUES (FDTs):

ISO 8807♦	LOTOS - A Formal Description Technique Based on the Temporal Ordering of Observational Behavior
	PDAD 1 Graphical Representation of LOTOS (G-LOTOS) (new work item proposal of December 1989 not accepted; status uncertain) [SC21 N 4871]
ISO 9074♦	Estelle - A Formal Description Technique Based on an Extended State Transition Model
	PDAD 1♦ Estelle Tutorial [SC21 N 4230]
DTR 10167	Guidelines for the Application of Estelle, LOTOS, and SDL [SC21 N 4259] (editing meeting scheduled September 1990)
CDTR xxxx♦	Architectural Semantics for FDTs, Revised Draft, July 1990, SC21/WG1 [SC21 N 5116]
SC21 N 3132	TTCN Operational Semantics, November 1988
CCITT X.250	Formal Description Techniques for Data Communications Protocols and Services
CCITT Z.100	Specification and Description Language (SDL)
CCITT Z.110	Criteria for the Use and Applicability of Formal Description Techniques

D. SECURITY:

ISO 8372	Information Processing - Modes of Operation for a 64-bit Block Cipher Algorithm, 1987
ISO 9160	Information Processing - Data Encipherment - Physical Layer Interoperability Requirements, 1988
DIS[12] 9796	Information Processing - Digital Signature Scheme Giving Message Recovery, 1989
ISO 9797	Information Processing - Data Cryptographic Techniques - Data Integrity Mechanisms Using a Cryptographic Check Function Employing a Block Cypher Algorithm, 1989
DIS 9798-1	Information Processing - Entity Authentication Mechanisms - Part 1: General Model
DP[13] 9798-2	Information Processing - Entity Authentication Mechanisms - Part 2: Entity Authentication Mechanisms Using Symmetric Algorithms
ISO 9979	Information Processing - Data Encipherment - Procedures for the Registration of Cryptographic Algorithms, July 1990 [SC27 N 88]

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12 DIS: Draft International Standard for ISO.

13 DP: Draft Proposal for an ISO standard [to be issued as Committee Drafts (CDs) beginning in 1990].

DIS 10116	Information Processing - Modes of Operation for an N-bit Block Cipher Algorithm, 1989 [SC27 N 86]
WD[14] 10181-1♦	Security Frameworks in Open Systems - Part 1: Overview (CD text expected June 1991), December 1989 [SC21 N 4210]
DP 10181-2♦	Security Frameworks in Open Systems - Part 2: Authentication Framework, December 1989 [SC21 N 4207]
WD 10181-3♦	Security Frameworks in Open Systems - Part 3: Access Control Framework (CD text expected October 1990), December 1988 [SC21 N 3261]
WD 10181-4♦	Security Frameworks in Open Systems - Part 4: Non-Repudiation Framework (CD text expected June 1991), December 1988 [SC21 N 3263]
WD 10181-5♦	Security Frameworks in Open Systems - Part 5: Confidentiality Framework (CD text expected June 1991), December 1988 [SC21 N 3274]
WD 10181-6♦	Security Frameworks in Open Systems - Part 6: Integrity Framework (CD text expected June 1991), December 1988 [SC21 N 3264]
WD 10181-7	Security Frameworks in Open Systems - Part 7: Audit Trail Framework, 1989 [SC21 N 3338]
DP 10646	Information Processing - Multiple octet Coded Character Set, 14 November 1989 [SC21 N 4627]
WD xxxx-1	Cryptographic Mechanisms for Key Management, Part 1: Key Management Overview [SC27/WG2]
WD xxxx-2	Cryptographic Mechanisms for Key Management, Part 2: Key Management Using Secret Key Techniques [SC27/WG2]
WD xxxx-3	Cryptographic Mechanisms for Key Management, Part 3: Key Management Using Public Key Techniques [SC27/WG2]
WD xxxx-4	Cryptographic Mechanisms for Key Management, Part 4: Key Management Using Public Key Register [SC27/WG2]
JTC1 N 474	Proposal for a New Work Item: OSI Upper Layers Security Model, 21 July 1989
SC21 N 3141	Response to SC21 N 2864, Issues Concerning the Requirements for Security Services in the Presentation Layer, November 1988 [SC21/WG1]
SC21 N 3167	Response to SC18 Liaison on Encryption, January 1989 [SC21/WG3]
SC21 N 3266	Guide for Open Systems Security, December 1988 [SC21/WG1]
SC21 N 3267	Plan for Work on Security in SC21, December 1988 [SC21/WG1]
SC21 N 3283	Working Draft for Lower-Layer Security Model, December 1988 [SC21/WG1]
SC21 N 3337	Security Management Domain and Security Policies
SC21 N 3991	Security Exchange Service Element, CCITT Q19/VII(DAF), November 1989 (CD text in SC21/WG6 expected in 1992)
SC21 N 4526	Application Layer Security Considerations, Workshop of Distributed Applications, 18 April 1990
SC21 N 4648	Security and Security Exchange Information, 28 February 1990, Canadian contribution to SC21/WG6
SC21 N 4833	Report to JTC1 from SC27 on Security Techniques, SC27 Secretariat, 21 May 1990 [SC27 N 94, 3 May 1990]

[14] WD: Working Draft for ISO (status of text prior to being submitted as a Committee Draft).

SC21 N 4834	Liaison Statement from SC27 to JTC1 Advisory Group, SC27 Secretariat, 21 May 1990 [SC27 N 93, 3 May 1990]
SC21 N 4835	Report of the First Plenary Meeting of SC27 at Stockholm, 24-26 April 1990, SC27 Secretariat, 21 May 1990 [SC27 N 92, 1 May 1990]
SC21 N 4836	Resolutions Taken at the First Plenary Meeting of SC27 at Stockholm, 24-26 April 1990, 21 May 1990 [SC27 N 94, 3 May 1990]
SC21 N 5001	Upper Layers Security Model, Third Working Draft, SC21/WG6, 5 June 1990 (CD text expected in 1991)
SC21 N 5002	Commencement of Work on Security ASEs, SC21/WG6, 31 May 1990
SC21 N 5003	Distributed Applications Security Modelling and Infrastructure, SC21/WG6, July 1991

E. OSI MANAGEMENT:

DIS 10040♦	Systems Management Overview, July 1990 [SC21 N 4685] (IS text expected July 1991)
DIS 10165-1♦	Structure of Management Information - Part 1: Management Information Model, July 1990 [SC21 N 4484] (IS text expected July 1991)
DIS 10165-2♦	Structure of Management Information - Part 2: Definition of Management Information, July 1990 [SC21 N 4867] (IS text expected August 1991)
DIS 10165-4♦	Structure of Management Information - Part 4: Guidelines for the Definition of Managed Objects, July 1990 [SC21 N 4852] (IS text expected July 1991)
ISO 9595♦	Common Management Information Service (CMIS) Definition, 15 May 1990
	DAD[15] 1♦ CancelGet Service, 1 February 1990 [SC21 N 3876] (IS text expected November 1990)
	DAD 2♦ Add/Remove Service, 1 February 1990 [SC21 N 3877] (IS text expected November 1990)
	PCDAM[16] 3 Support of Allomorphism, July 1990 [SC21 N 4966] (CD text expected November 1990)
	PCDAM 4 Access Control [SC21 N 4969] (CD text expected November 1990)
ISO 9596♦	Common Management Information Protocol (CMIP) Specification
	DAD 1♦ CancelGet Service, 1 February 1990 [SC21 N 3878] (IS text expected November 1990)
	DAD 2♦ Add/Remove Service, 1 February 1990 [SC21 N 3879] (IS text expected November 1990)
	PCDAM 3 Support of Allomorphism, July 1990 [SC21 N 4967] (CD text expected November 1990)
	PCADM 4 State Table (new work item; CD text expected July 1991)
WD 9596-2	Common Management Information Protocol (CMIP) Specification, Part 2: PICS Proforma [SC21 N 4965] (CD text expected November 1990)
DIS 10164-1♦	Systems Management - Part 1: Object Management Function, July 1990 [SC21 N 4067, December 1989]

15 DAD: Draft Addendum to ISO standard.

16 PCDAM: Proposed Committee Draft Amendment for ISO.

DIS 10164-2♦	Systems Management - Part 2: State Management Function, July 1990 [SC21 N 4068, December 1989]
DIS 10164-3♦	Systems Management - Part 3: Relationship Management Function, July 1990 [SC21 N 4069, December 1989]
DIS 10164-4♦	Systems Management - Part 4: Alarm Reporting Function, July 1990 [SC21 N 4070, December 1989]
DIS 10164-5♦	Systems Management - Part 5: Event Report Management Function, July 1990 [SC21 N 4071, December 1989]
DIS 10164-6♦	Systems Management - Part 6: Log Control Function, July 1990 [SC21 N 4063, December 1989]
DIS 10164-7♦	Systems Management - Part 7: Security Alarm Reporting Function, July 1990 [SC21 N 4064, December 1989]
CD 10164-8	Systems Management - Part 8: Security Audit Trail Function, July 1990 [SC21 N 4955]
CD 10164-9	Systems Management - Part 9: Objects and Attributes for Access Control, July 1990 [SC21 N 4956]
CD 10164-10	Systems Management - Part 10: Accounting Meter Function, July 1990 [SC21 N 4958]
CD 10164-11	Systems Management - Part 11: Workload Monitoring Function, July 1990 [SC21 N 4959]
WD 10164-X	Systems Management - Part X: Software Management Function, July 1990 [SC21 N 4976] (CD text expected November 1990)
WD 10164-Y	Systems Management - Part Y: Test Management Function, July 1990 [SC21 N 4978] (CD text expected November 1990)
WD 10164-Z	Systems Management - Part Z: Confidence and Diagnostic Test Classes, July 1990 [SC21 N 4957] (CD text expected November 1990)
WD 10164-A	Systems Management - Part A: Time Management Function, July 1990 [SC21 N 4953] (new work item; CD text expected November 1990)
WD 10164-B	Systems Management - Part B: Measurement Summarization Function, Second Working Draft, July 1990 [SC21 N 4972] (CD text expected November 1990)
WDTR[17] xxxx	Systems Management Tutorial, July 1990, SC21/WG4 [SC21 N 4942] (CCITT X.702)
WDTR xxxx, Annex A	Systems Management Tutorial - Annex A: Access Control, 30 May 1990 [SC21 N 4970]
SC6 N 5447	Liaison Statement to SC21/WG4 on Lower Layer Management, 13 October 1990
SC6 N 5784	General Principles for the Definition of Lower Layer Management, 2nd Draft, JTC1 SC6/WG2/WG4, April 1990
SC21 N 3307	WG4 Architecture Issues List
SC21 N 3311♦	Configuration Management Overview
SC21 N 3316	Access Control for OSI Management and The Directory
SC21 N 3317	Working Document on Extended Information Models
SC21 N 3318	Working Document on the Directory Schema
SC21 N 3319	Working Document on Replication and Knowledge Distribution

[17] WDTR: Working Draft Technical Report for ISO.

SC21 N 3320	Working Document on Access Control
SC21 N 3321	Working Document on Enhanced Search
SC21 N 3322	Working Document on Attribute Classes
SC21 N 3323	Request for National Body and CCITT Member Contributions on Directory PICS Proforma
SC21 N 4058	State Tables for CMIP, January 1990
SC21 N 4077♦	Fault Management Working Document, SC21/WG4, December 1989
SC21 N 4085♦	Accounting Management Working Document, Third Version, SC21/WG4, November 1989
SC21 N 4091♦	OSI Security Management Working Document, 15 November 1989
SC21 N 4906	Upper Layer Management - Call for Contributions, SC21/WG6, June 1990
SC21 N 4943	Extended Systems Management Architecture, July 1990 (planned to be an amendment to DIS 10040)
SC21 N 4944	Generic Managed Objects, July 1990
SC21 N 4945	Definition of a Management Information Register and Registration Procedures, July 1990
SC21 N 4946	Requirements and Guidelines for Managed Object Conformance Statement (MOCS) Proformas, July 1990
SC21 N 4947	Formal Descriptions of CMIP, July 1990
SC21 N 4948	Systems Management Relationship Model, July 1990 (expected to use entity-relationship modelling)
SC21 N 4949	Systems Management: Response Time Monitoring, July 1990
SC21 N 4960	Generic Managed Objects, Working Draft, SC21/WG4, July 1990
SC21 N 4961	Request for Contributions to Progress Work on the Definition of State Tables for CMIP, May 1990
SC21 N 4968	Synchronization Across Multiple Managed Objects, SC21/WG4, July 1990
SC21 N 4969	Call for National Body Contributions on Time Management, SC21/WG4, May 1990
SC21 N 4973	The Use of System Title by OSI Management, SC21/WG4, July 1990
SC21 N 4974	Use of Global Naming for Identification of Managed Objects, SC21/WG4, July 1990
SC21 N 4975	A General Model for Relationship Management, SC21/WG4, 31 May 1990]
SC21 N 4977	Use of Action to Invoke State Changes, SC21/WG4, July 1990
SC21 N 4979	Request for National Body Comment on the Need for an Access Control Information Management Function, SC21/WG4, May 1990
SC21 N 4980	Security Audit Framework Working Document, SC21/WG4, July 1990
SC21 N 4981♦	Performance Management Working Document, Sixth Working Draft, 4 July 1990
SC21 N 4982	WG4 Systems Management Issues, SC21/WG4, July 1990
SC21 N 5079	Draft Answer to Q1/63.1 on Conformance to Objects in the Context of OSI Management, SC21/WG1, May 1990
SC21 N 5080	Call for Contributions on OSI Management Conformance Issues, SC21/WG1, July 1990

F. OSI REGISTRATION AUTHORITIES:

DIS 9834-1♦	Procedures for Specific OSI Registration Authorities - Part 1: General Procedures, March 1990 [SC21 N 4352] (DIS ballot suspended and expected to restart in August 1990; IS text expected June 1991)
DIS 9834-2♦	Procedures for Specific OSI Registration Authorities - Part 2: Registration Procedures for Document Types, 1990 [SC21 N 2605, May 1988] (DIS ballot suspended and expected to restart in August 1990; IS text expected June 1991)
ISO 9834-3♦	Procedures for Specific OSI Registration Authorities - Part 3: Procedures for Specific Registration of Joint Object Identifier Component Values for Joint ISO-CCITT Use, April 1990 [SC21 N 4718]
DIS 9834-4♦	Procedures for Specific OSI Registration Authorities - Part 4: Register of VT Profiles, March 1990 [SC21 N 4325] (DIS ballot suspended and expected to restart in August 1990; IS text expected July 1991)
DIS 9834-5♦	Procedures for Specific OSI Registration Authorities - Part 5: Register of VT Control Object Definitions, March 1990 [SC21 N 4322] (DIS ballot suspended and expected to restart in August 1990; IS text expected July 1991)
DP 9834-6	Procedures for Specific OSI Registration Authorities - Part 6: Registration Authority Procedures for Application Process Titles and Application Entity Titles, July 1989 (DIS text expected August 1990)
WD 9834-B	Procedures for Specific OSI Registration Authorities - Part B: Registration of Abstract Syntaxes
WD 9834-C	Procedures for Specific OSI Registration Authorities - Part C: Registration of Transfer Syntaxes
WD 9834-D	Procedures for Specific OSI Registration Authorities - Part D: Registration of Application Contexts
WD 9834-E	Procedures for Specific OSI Registration Authorities - Part E: Registration of System Titles
WD 9834-F	Procedures for Specific OSI Registration Authorities - Part F: Registration of Authentication Mechanisms
TR 9973	Registration of Graphical Items
WD xxxx	Registration of System Titles (DP expected November 1990)
SC21 N 5014	Liaison Statement to CCITT SG VII (Q.23) on Collaborative Work on OSI Registration, 6 June 1990

G. OSI CONFORMANCE TESTING:

DIS 9646-1.2♦	OSI Conformance Testing Methodology and Framework - Part 1: General Concepts, April 1989 (IS text expected September 1990)
DIS 9646-2.2♦	OSI Conformance Testing Methodology and Framework - Part 2: Abstract Test Suite Specification, April 1989 (IS text expected September 1990)
	WDAD[18] 1 Testing and Formal Description Techniques (FDTs)
DIS 9646-3♦	OSI Conformance Testing Methodology and Framework - Part 3: Executable Test Derivation, May 1990
	WDAD 1 TTCN Extensions, July 1990 [SC21 N 5077]

[18] WDAD: Working Draft Addendum to ISO standard.

DIS 9646-4♦	OSI Conformance Testing Methodology and Framework - Part 4: Test Realization (Requirements for Implementors), June 1989 (IS text expected September 1990)
DIS 9646-5♦	OSI Conformance Testing Methodology and Framework - Part 5: Requirements on Test Laboratories and Clients for the Conformance Assessment Process (Test Execution), June 1989 (IS text expected September 1990)
DP 9646-6	OSI Conformance Testing Methodology and Framework - Part 6: Interpretation of Test Report, 1989
WD xxxx	Multi-Party Testing Methodology, July 1990, SC21/WG1 [SC21 N 5076] (CD text expected October 1990)
DTR xxxx	Catalogue of PICS Proforma Notations, July 1990 (joint work of WG1 and CCITT SG VII; meeting scheduled for February 1991)
SC21 N 4215	Formal Methods in Conformance Testing (new work item, January 1990)
SC21 N 5075	Protocol Profile Testing Methodology, Second Working Draft, SC21/WG1, July 1990
SC21 N 5078	Catalogue of PICS Proforma Notations, SC21/WG1, July 1990
SC21 N 5117	Multiparty Testing for MHS, SC21/WG1, July 1990
CCITT X.290	OSI Conformance Testing Methodology and Framework for Protocol Recommendations for CCITT Applications (see DP 9646-1 and DP 9646-2)

H. TAXONOMY AND PROFILES:

STANAG 4257♦	NATO Standard Profile on Military Message Handling System (MMHS), Draft, February 1990
STANAG xxxx♦	NATO Standard Profile on R.131(M), Draft, 1989
STANAG xxxx♦	NATO Standard Profile on TC 111(M), Draft, Version 1.3, 13 July 1990
STANAG xxxx♦	NATO Standard Profile on TA 51(M), Draft, Version 2.0, 23 July 1990
TR 10000-1♦	International Standardized Profiles (ISPs) - Part 1: Taxonomy Framework, 9 February 1990 [JTC1 SGFS, SGFS N 184]
TR 10000-2♦	ISPs - Part 2: Taxonomy of Profiles, 9 February 1990 [JTC1 SGFS, SGFS N 185]
DISP 10607-1	ISPs - AFT nn - File Transfer, Access, and Management - Part 1: Specification of ACSE, Presentation and Session Protocols for the Use by FTAM, 26 April 1990 [SGFS N 131] (submitted by SPAG)
DISP 10607-2	ISPs - AFT nn - File Transfer, Access, and Management - Part 2: Definition of Document Types, Constraint Sets and Syntaxes, 26 April 1990 [SGFS N 131] (submitted by SPAG)
DISP 10607-3	ISPs - AFT nn - File Transfer, Access, and Management - Part 3: AFT 11 - Simple File Transfer Service (Unstructured), 26 April 1990 [SGFS N 131] (submitted by SPAG)
WDISP 10607-4	ISPs - AFT nn - File Transfer, Access, and Management - Part 4: AFT 12 - Positional File Transfer Service, July 1990
WDISP 10607-5	ISPs - AFT nn - File Transfer, Access, and Management - Part 5: AFT 22 - Positional File Access Service, July 1990
WDISP 10607-6	ISPs - AFT nn - File Transfer, Access, and Management - Part 6: AFT 12 - File Management Service, July 1990

SGFS N 201	ISPs - Taxonomy Update, ISP Approval, and Maintenance Process, 7 May 1990 (standing SGFS document)
SC21 N 3674	ISPs - Directory of ISPs and Profiles Contained Therein, June 1989
SC21 N 3675	ISPs - ISP Approval and Maintenance Process, June 1989
SC21 N 3678	ISPs - Proposed New AMH Taxonomy, June 1989
SC21 N 4716	Initial List of Planned PDISPs, 30 April 1990
ENV[19] 41 101♦	LANs: Provision of the OSI Connection-Mode Transport Service (COTS) Service Using the Connectionless-Mode Network Service (CLNS) on a CSMA/CD Single LAN, June 1986
ENV 41 102♦	LANs: Provision of the OSI COTS and the CLNS on a CSMA/CD Single or Multiple LAN Configuration, June 1986
ENV 41 103♦	LANs: Provision of the OSI COTS and the Connection-Mode Network Service (CONS) in an End System on a CSMA/CD LAN, December 1987
ENV 41 104	Packet Switched Data Networks: Permanent Access, August 1987
ENV 41 105♦	Packet Switched Data Networks: Switched Access, June 1988
ENV 41 106♦	Digital Data Circuit (CSDN) - Provision of the OSI COTS in the T.70 Case for Telematic End Systems, June 1988
ENV 41 107♦	Digital Data Circuit (CSDN) - Provision of the OSI COTS and the OSI CONS, June 1988
ENV 41 108♦	LANs: Provision of the OSI COTS and CONS in an End System on a Token Ring LAN, May 1988
ENV 41 109♦	LANs: Provision of the OSI COTS Using CLNS on a Token Ring Single LAN, February 1988
ENV 41 110♦	LANs: Provision of the OSI COTS Using CLNS in an End System on a Token Ring LAN in a Single or Multiple LAN Configuration, February 1988
ENV 41 201	Private Message Handling System - User Agent and Message Transfer Agent; Private Management Domain to Private Management Domain, June 1986
ENV 41 202	Message Handling Systems; User Agent and Message Transfer Agent: Access to an Administration Management Domain (ADMD), August 1987
ENV 41 203	Exchange of Telex Documents Between Two End Systems, Which May Be Teletex Terminals, June 1988
ENV 41 204♦	FTAM: Simple File Transfer, June 1988
ENV 41 205♦	FTAM: File Management, June 1987
ENV 41 901	X.29-Mode Procedures Between a Packet Mode DTE or a PAD and a PAD via a Public or Private X.25 Packet Switched Network or ISO 8208 Packet Level Entity and ISO 7776 Link Level Entity, June 1987
M-IT-02	Directory of Functional Standards (For Interworking in an OSI Environment) Adopted by the CEN/CENELEC/CEPT/ITSTC, March 1987

[19] ENV indicates an interim standard approved by the Join European Standards Institution (CEN/CENELEC) and the European Workshop for Open Systems (EWOS).

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II. LAYER 1: PHYSICAL LAYER[20]

A. GENERAL:

STANAG 4251♦	NATO Reference Model for OSI - Layer 1 (Physical Layer) Service Definition, Draft, July 1990
STANAG 4261♦	NATO Reference Model for OSI - Layer 1 (Physical Layer) Protocol Specification, Draft, July 1990
ISO 9160	Physical Layer Interoperability Requirements
DIS 9316	Small Computer System Interface (SCSI)
DIS 9318	Intelligent Peripheral Interface - Physical Level
DIS 10022♦	Physical Service Definition
CCITT X.211	Physical Service Definition for OSI for CCITT Applications (see DIS 10022), 1988 Blue Books

B. MECHANICAL:

ISO 2110.3♦	25-Pin DTE/DCE Interface Connector and Pin Assignments (Revision of ISO 2110)
	PDAD 1 Interface Connector and Contact Number Assignments for a DTE/DCE for Data Signalling Rates Above 20 kbit/s
ISO 2593♦	34-Pin DTE/DCE Interface Connector and Pin Assignments
ISO 4902♦	37-Pin DTE/DCE Interface Connector and Pin Assignments (Revision of ISO 4902)
ISO 4903♦	15-Pin DTE/DCE Interface Connector and Pin Assignments (Revision of ISO 4903)
TR 7477♦	Arrangements for DTE/DTE Physical Connection Using V.24 and X.24 Interchange Circuits
ISO 8481♦	DTE/DTE Physical Connection Using X.24 Interchange Circuits with DTE-Provided Timing
ISO 8877♦	Interface Connector and Contact Assignments for ISDN Basic Access Interface Located at Reference Points S and T
	DAD 1♦ Standard ISDN Basic Access TE Connecting Cord
DP 10173	ISDN Primary Access Connector at Reference Points S and T
CCITT I.340	ISDN Connection Types

C. ELECTRICAL:

ISO 8482♦	Twisted Pair Multipoint Interconnections

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[20] The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

DIS 9549♦	Galvanic Isolation of Balanced Interchange Circuits
CCITT V.5	Data Signalling Rates for Synchronous Data Transmission in the General Switched Telephone Network
CCITT V.6	Data Signalling Rates for Synchronous Data Transmission on Leased Telephone-Type Circuits
CCITT V.28♦	Electrical Characteristics for Unbalanced Double-Current Interchange Circuits
CCITT V.31♦	Electrical Characteristics for Single-Current Interchange Circuits Controlled by Contact Closure
CCITT V.31 bis♦	Electrical Characteristics for Single-Current Interchange Circuits Using Opto Couplers
CCITT V.35♦	Data Transmission at 48 kbit/s Using 60-108 kHz Group Band Circuits
CCITT V.36♦	Modems for Synchronous Data Transmission Using 60-108 kHz Group Band Circuits

D. FUNCTIONAL:

ISO 7480♦	Start-Stop Transmission Signal Quality at DTE/DCE Interfaces
ISO 9543♦	Synchronous Transmission Signal Quality at DTE/DCE Interfaces
CCITT I.411	ISDN User-Network Interfaces - Reference Configuration
CCITT I.412	ISDN User-Network Interfaces - Interface Structures and Access Capabilities
CCITT X.1	International User Classes of Service in Public Data Networks and Integrated Services Digital Networks (ISDNs)
CCITT X.4	General Structure of Signals of International Alphabet No. 5 Code for Data Transmission Over Public Data Networks
CCITT X.10	Categories of Access for DTE to Public Data Transmission Services Provided by PDNs and/or ISDNs through Terminal Adaptors
CCITT X.24♦	List of Definitions for Interchange Circuits Between DTE and DCE on Public Data Networks

E. PROCEDURAL:

ISO 8480♦	DTE/DCE Back-Up Control Operation Using the 25-Pole Connector
ISO 9067♦	Automatic Fault Isolation Procedures Using Test Loops
CCITT I.420	Basic User-Network Interface (ISDN)
CCITT I.421	Primary Rate User-Network Interface (ISDN)
CCITT I.430♦	Basic User-Network Interface - Layer 1 Specification (ISDN)
CCITT I.431♦	Primary Rate User-Network Interface - Layer 1 Specification (ISDN)
CCITT I.460♦	Multiplexing, Rate Adaptation and Support of Existing Interfaces (ISDN)
CCITT I.461♦	Support of X.21 and X.21 bis Based DTEs by an ISDN (X.30)
CCITT I.462♦	Support of Packet Mode Terminal Equipment by an ISDN (X.31)
CCITT I.463♦	Support of DTEs with V-Series Type Interfaces by an ISDN
CCITT I.464♦	Multiplexing Rate Adaptation and Support of Existing Interfaces for Restricted 64 kbit/s Transfer Capability

CCITT V.10/X.26♦	Electrical Characteristics for Unbalanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communication
CCITT V.11/X.27♦	Electrical Characteristics for Balanced Double-Current Interchange Circuits for General Use With Integrated Circuit Equipment in the Field of Data Communications
CCITT V.20♦	Telex and Gentex Signalling on Radio Channels (Synchronous 7-Unit Systems Affording Error Correction by Automatic Repetition)
CCITT V.24♦	List of Definitions for Interchange Circuits Between DTE and DCE
CCITT V.25	Automatic Answering Equipment and/or Parallel Automatic Calling Equipment on the General Switched Telephone Network Including Procedures for Disabling of Echo Control Devices for Both Manually and Automatically Established Calls
CCITT V.28♦	Electrical Characteristics for Unbalanced Double-Current Interchange Circuits
CCITT V.31♦	Electrical Characteristics for Single-Current Interchange Circuits Controlled by Contact Closure
CCITT V.31 bis♦	Electrical Characteristics for Single-Current Interchange Circuits Using Opto Couplers
CCITT V.35♦	Data Transmission at 48 kbit/s Using 60-108 kHz Group Band Circuits, 1988
CCITT V.36♦	Modems for Synchronous Data Transmission Using 60-108 kHz Group Band Circuits, 1988
CCITT V.37♦	Synchronous Data Transmission at a Data Signalling Rate Higher than 72 kbit/s Using 60-108 kHz Group Band Circuits
CCITT V.54	Loop Test Devices for Modems
CCITT X.20♦	Interface Between DTE and DCE for Start-Stop Transmission Services on Public Data Networks
CCITT X.20 bis	Use on Public Data Networks of DTE Which Is Designed for Interfacing to Asynchronous Duplex V-Series Modems
CCITT X.21♦	Interface Between DTE and DCE for Synchronous Operation on Public Data Networks
CCITT X.21 bis♦	Use on Public Data Networks of DTE Which Is Designed for Interfacing to Synchronous V-Series Modems
CCITT X.22♦	Multiplex DTE/DCE Interface for User Classes 3-6
CCITT X.31♦	Support of Packet Mode Terminal Equipment by an ISDN
CCITT X.32♦	Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Accessing a Packet Switched PDN Through a Public Switched Telephone Network or a Circuit Switched PDN
CCITT X.150	Principles of Maintenance Testing for Public Data Networks Using DTR and DCE Test Loops

F. LOCAL AREA NETWORKS (LANs):

DP 8802-1♦	LANs - Part 1: General Introduction	
ISO 8802-2.2♦	LANs - Part 2: Logical Link Control	
	DAD 1♦	Flow Control Techniques for Bridged LANs
	DAD 2♦	Type 3 Operation - Acknowledge Connectionless Service
	PDAD 4	Editorial Changes and Technical Corrections, June 1989
ISO 8802-3♦	LANs - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) - Access Method and Physical Layer Specifications	
	DAD 1♦	Physical Signalling, Medium Attachment, and Baseband Medium Specifications for Type 1BASE5
	DAD 2♦	Repeater Set and Repeater Unit Specification for Use with 10BASE5 and 10 BASE2 Networks
	DAD 3♦	Broadband Medium Attachment Unit and Broadband Medium Specifications, Type 10BROAD36
	PDAD 4♦	CSMA/CD, STARLAN, 1BASE5
	DAD 5♦	Medium Attachment Baseband Medium Specification for a Vendor-Independent Fibre Optic Inter Repeater Link (FOIRL)
ISO 8802-4.2♦	LANs - Part 4: Token-Passing Bus Access Method and Physical Layer Specifications	
ISO 8802-5♦	LANs - Part 5: Token Ring Access Method and Physical Layer Specifications	
	PDAD 1	4 and 16 Mbit/s Specification
	PDAD 2	MAC Sublayer Enhancement
	PDAD 3	Management Entity Specification
	PDAD 4	Source Routing MAC Bridge
DIS 8802-6♦	LANs - Part 6: Distributed Queue Dual Bus (DQDB) Media Access Control (MAC)	
ISO 8802-7♦	LANs - Part 7: Slotted Ring Access Method and Physical Layer Specification	
DIS 8802-9♦	LANs - Part 9: Integrated Voice and Data (IVD) LAN	
ISO 9314-1♦	Fibre Distributed Data Interface (FDDI) - Part 1: Physical Layer Protocol (PHY)	
ISO 9314-2♦	FDDI - Part 2: Media Access Control (MAC)	
DIS 9314-3♦	FDDI - Part 3: Physical Layer Medium Dependent (PMD)	
DTR 9578	Communication Interface Connectors Used in LANs	
DP 10038♦	MAC Sublayer Interconnection (MAC Bridging)	
DIS 10039♦	MAC Service Definition	

III. LAYER 2: DATA LINK LAYER[21]

A. GENERAL:

STANAG 4252♦	NATO Reference Model for OSI - Layer 2 (Data Link Layer) Service Definition, Draft, July 1990
STANAG 4262♦	NATO Reference Model for OSI - Layer 2 (Data Link Layer) Protocol Specification, Draft, July 1990
ISO 8886.3[22]♦	Data Link Service Definition for OSI
DTR 10171♦	List of Standard Data Link Layer Protocols That Utilize HDLC Classes of Procedures, 1989
CCITT X.212	Data Link Service Definition for OSI for CCITT Applications (see ISO 8886), 1988 Blue Books

B. CHARACTER-ORIENTED SERVICE (BASIC MODE):

ISO 1155	Use of Longitudinal Parity to Detect Errors in Information Messages
ISO 1177	Character Structure for Start/Stop and Synchronous Character Oriented Transmission
ISO 1745	Basic Mode Control Procedures for Data Communication Systems
ISO 2111	Basic Mode Control Procedures - Code Independent Information Transfer
ISO 2628	Basic Mode Control Procedures - Complements
ISO 2629	Basic Mode Control Procedures - Conversational Information Message Transfer

C. BIT-ORIENTED SERVICE (HIGH-LEVEL DATA LINK CONTROL PROCEDURES [HDLC]):

ISO 3309♦	HDLC - Frame Structure	
	DAD 1♦	Start/Stop Transmission
	WAD 2	Extended Transparency Option
ISO 4335♦	HDLC - Elements of Procedures	
	AD 1♦	Asynchronous (Start/Stop) Transmission Operation
	AD 2♦	Enhancement of the XID Function Utility
	DAD 3♦	Start/Stop Transmission
	PDAD 4♦	Flow Control Unnumbered Information (FUI)
	PDAD 5	Multi-Selective Reject
ISO 7478♦	Multilink Procedures	

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21 The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

22 For ISO standards, the decimal indicates the version number; thus, DIS 8886.3 is Version 3 (no decimal indicates Version 1).

ISO 7776♦	HDLC - Description of the X.25 LAPB-Compatible DTE Data Link Procedures	
	PDAD 1	PICS Proforma
ISO 7809♦	HDLC - Consolidation of Classes of Procedures	
	AD 1♦	UI Command/Response
	AD 2♦	Descriptions of Optional Functions
	DAD 3♦	Stop/Start Transmission
	PDAD 4♦	List of Standard Data Link Layer Protocols that Utilize HDLC Classes of Procedures [see DTR 10171]
	PDAD 5	Connectionless Class of Procedure
	PDAD 6	Extended Transparency Option
	PDAD 7	Multi-Selective Reject
ISO 8471♦	HDLC Balanced Classes of Procedures - Data Link Layer Address Resolution/ Negotiation in Switched Environments	
ISO 8885♦	HDLC - General Purpose XID Frame Information Field Content and Format	
	DAD 1♦	Additional Operational Parameters for the Parameter Negotiation Data Link Layer Subfield and Definition of a Multilink Parameter Negotiation Data Link Layer Subfield
	DAD 2♦	Stop/Start Transmission
	PDAD 3♦	Definition of a Private Parameter Negotiation Data Link Layer Subfield
	PDAD 4	Extended Transparency Option
	PDAD 5	Multi-Selective Reject
CCITT T.71♦	LAPB Extended for Half-Duplex Physical Level Facility	

D. INTEGRATED SERVICES DIGITAL NETWORK (ISDN):

CCITT I.440	ISDN User-Network Interface Data Link Layer - General Aspects
CCITT I.441♦	ISDN User-Network Interface Data Link Layer - Specification

E. ERROR CORRECTION:

CCITT X.141	General Principles for the Detection and Correction of Errors in Public Data Networks

F. CONFORMANCE SUITE:

DP 8882-2♦	Data Link Layer Conformance Test Suite

IV. LAYER 3: NETWORK LAYER[23]

A. GENERAL:

STANAG 4253♦	NATO Reference Model for OSI - Layer 3 (Network Layer) Service Definition, Draft, July 1990
STANAG 4263♦	NATO Reference Model for OSI - Layer 3 (Network Layer) Protocol Specification, Draft, July 1990
ISO 8348♦	Network Service Definition
	AD 1♦ Connectionless-Mode Transmission
	AD 2♦ Network Layer Addressing
	AD 3♦ Additional Features of the Network Service
ISO 8648♦	Internal Organization of the Network Layer
ISO 8880-1♦	Protocol Combination to Provide and Support the OSI Network Service - Part 1: General Principles
ISO 8880-2♦	Protocol Combination to Provide and Support the OSI Network Service - Part 2: Provision and Support of the Connection-Mode Network Service
ISO 8880-3♦	Protocol Combination to Provide and Support the OSI Network Service - Part 3: Provision and Support of the Connectionless-Mode Network Service
WD 8880-4♦	Protocol Combination to Provide and Support the OSI Network Service - Part 4: Interconnection of OSI Environments
DTR 9577♦	Protocol Identification in the OSI Network Layer
PDTR[24] 10172	Network/Transport Protocol Interworking Specification
ISO 10177	Intermediate-System Support of the OSI Connection-Mode Network Service Using ISO 8208 in Accordance with ISO 10028, 13 October 1989
SC21 N 4347	Progression of Work on Network Layer Management, SC6/WG2, January 1990 [SC21 N 4630]
CCITT T.70♦	Network-Independent Basic Transport Service for the Telematic Services
CCITT X.213	Network Service Definition for OSI for CCITT Applications

B. PACKET-SWITCHED SERVICE:

ISO 8208♦	X.25 Packet Level Protocol (PLP) for DTE
	DAD 1.2♦ Alternative Logical Channel Number Allocation
	PDAD 2♦ Extensions for Private Switched Use (WITHDRAWN, 1989)
	DAD 3♦ Conformance Requirements

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[23] The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

[24] PDTR: Proposed Draft Technical Report for ISO.

ISO 8878♦	Use of X.25 to Provide the OSI Connection-Mode Network Service
	DAD 1 Protection and Priority
	DAD 2 Use of an X.25 PVC to Provide the OSI CONS
	PDAD 3 Conformance
	WDAD 4 PICS Proforma
ISO 8881.3♦	Use of the X.25 PLP in LANs
ISO 8882-1♦	X.25-DTE Conformance Testing - Part 1: General Principles
DP 8882-2♦	X.25-DTE Conformance Testing - Part 2: Data Link Conformance Test Suite
DIS 8882-3♦	X.25-DTE Conformance Testing - Part 3: Packet Level Conformance Test Suite
CCITT X.25(84)♦	Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit
CCITT X.75(84)♦	Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits Between PSDNs
CCITT X.223	Use of X.25 to Provide the OSI Connection-Mode Network Service for CCITT Applications (see ISO 8878)
CCITT X.244	Procedure for the Exchange of Protocol Identification During Virtual Call Establishment on Packet Switched Public Data Networks

C. CONNECTIONLESS SERVICE:

ISO 8473♦	Protocol for Providing the Connectionless-Mode Network Service
	PDAD 1♦ Provision of the Underlying Service Assumed by ISO 8473 Over Point-to-Point Subnetworks Which Provide the OSI Data Link Service
	PDAD 2♦ Estelle Formal Description of ISO 8473 (to be reballoted as a DTR)
	AD 3♦ Provision of the Underlying Service Assumed by ISO 8473 over Subnetworks Which Provide the OSI Data Link Service
DIS 9068♦	Provision of the Connectionless Network Service Using ISO 8208
PDTR xxxx♦	Formal Description of ISO 8473

D. ISDN:

ISO 9574♦	Provision of the OSI Connection-Mode Network Service (CONS) by Packet Mode Terminal Equipment Connected to an Integrated Services Digital Network (ISDN)
	WDAD 1 Provision of the CONS on an ISDN Circuit-Switch Channel
CCITT I.450♦	ISDN User-Network Interface - Layer 3 - General Aspects
CCITT I.451♦	ISDN User-Network Interface - Layer 3 - Specification
CCITT I.461♦	Support of X.21 and X.21 bis Based DTEs by an ISDN (X.30)
CCITT I.462♦	Support of Packet Mode Terminal Equipment by an ISDN (X.31)
CCITT I.463♦	Support of DTEs with V-Series Type Interfaces by an ISDN

Note: Additional ISDN standards are listed in the last section of this Appendix.

E. ROUTING AND RELAY:

ISO 9542♦	End System to Intermediate System Routing Exchange Protocol for Use in Conjunction with the Protocol for Providing the Connectionless-Mode Network Service
DTR 9575♦	OSI Routing Framework, April 1988
DP 10028.2♦	Definition of the Relaying Functions of a Network Layer Intermediate System
TR 10029♦	Operation of an X.25 Interworking Unit
DIS 10030♦	End System to Intermediate System Routing Information Exchange Protocol for Use in Conjunction with ISO 8208 (X.25 PLP) [SC6 N 5006]
DP xxxx♦	Intermediate System Routing
SC6 N 4053	End System to Intermediate System Routing Exchange Protocol for Use in Conjunction With ISO 8473
CCITT X.110	International Routing Principles and Routing Plan for Public Data Networks
CCITT X.353	Routing Principles for Interconnecting the Maritime Satellite Data Transmission System With Public Data Networks

F. AUTOMATIC CALLING/ANSWERING EQUIPMENT:

CCITT V.25♦	Automatic Answering Equipment and/or Parallel Automatic Calling Equipment on the General Switched Telephone Network Including Procedures for Disabling of Echo Control Devices for Both Manually and Automatically Established Calls
CCITT V.25 bis♦	Automatic Calling and/or Answering Equipment on the General Switched Telephone Network (GSTN) Using the 100-Series Interchange Circuits

G. CIRCUIT SWITCHED SERVICE:

Covered by CCITT	X.21, X.24, X.26, X.27, ISO 4903, listed under Physical Layer Standards.

H. LOCAL AREA NETWORKS (LANs):

DP 10038♦	MAC Sublayer Interconnection (MAC Bridging)
DIS 10039♦	MAC Service Definition

Other standards are covered in the discussion of LAN standards for Layer 2 (Section III).

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V. LAYER 4: TRANSPORT LAYER[25]

A. GENERAL:

STANAG 4254♦	NATO Reference Model for OSI - Layer 4 (Transport Layer) Service Definition, Draft, July 1990
STANAG 4264♦	NATO Reference Model for OSI - Layer 4 (Transport Layer) Protocol Specification, Draft, July 1990
ISO 8072♦	Transport Service Definition
	AD 1♦ Connectionless-Mode Transmission
PDTR 10023♦	A Formal Description of ISO 8072 in LOTOS
PDTR 10172	Network/Transport Protocol Interworking Specification
CD xxxx♦	A Formal Description of the Transport Service Definition in Estelle
CD xxxx♦	A Formal Description of the Transport Protocol Specification in Estelle
CD xxxx♦	Transport Layer Management
CD xxxx♦	Transport Layer Security
CCITT T.70♦	Network-Independent Basic Transport Service for the Telematic Services
CCITT X.214	Transport Service Definition for OSI for CCITT Applications

B. CONNECTION-ORIENTED SERVICE:

ISO 8073♦	Connection Oriented Transport Protocol Specification
	AD 1♦ Network Connection Management Subprotocol
	DAD 2♦ Operation of Class 4 Over Connectionless Network Service
	DAD 3♦ Protocol Implementation Conformance Statement Proforma
PDTR 10024♦	A Formal Description of ISO 8073 in LOTOS
CCITT X.224	Transport Protocol Specification for OSI for CCITT Applications

C. CONNECTIONLESS SERVICE:

ISO 8073 DAD 2♦	Connection Oriented Transport Protocol Specification - Addendum 2: Operation of Class 4 Over Connectionless Network Service
ISO 8602♦	Protocol for Providing the Connectionless-Mode Transport Service

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[25] The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

D. CONFORMANCE TESTING:

DIS 10025-1♦	Transport Conformance Testing for Connection Oriented Transport Protocol Operating Over the Connection Oriented Network Service (CONS) - Part 1: General Principles
DP 10025-2♦	Transport Conformance Testing for Connection Oriented Transport Protocol Operating Over the Connection Oriented Network Service (CONS) - Part 2: Test Suite Structure and Test Principles
DP 10025-3♦	Transport Conformance Testing for Connection Oriented Transport Protocol Operating Over the Connection Oriented Network Service (CONS) - Part 3: Abstract Test Suite Specification

VI. LAYER 5: SESSION LAYER[26]

A. GENERAL:

STANAG 4255♦	NATO Reference Model for OSI - Layer 5 (Session Layer) Service Definition, Draft, April 1990
STANAG 4265♦	NATO Reference Model for OSI - Layer 5 (Session Layer) Protocol Specification, Draft, April 1990
ISO 8326♦	Basic Connection-Oriented Session Service Definition (equivalent to CCITT X.215), August 1987 (draft revised text of April 1990 incorporates AD1, AD2, and AD3); Technical Corrigendum, April 1990
AD 1♦	Session Symmetric Synchronization for the Session Service (not part of CCITT Recommendation), October 1989 [SC21 N 3507]
AD 2♦	Incorporation of Unlimited User Data, June 1988 [SC21 N 2495]
AD 3♦	Connectionless-Mode Session Service, August 1989 [SC21 N 3462]
WDAM[27] 4	Additional Resynchronization Functionality, July 1990 [SC21 N 5040] (CD text expected October 1990)
TR 9571♦	LOTOS Description of the Session Service, January 1989 [SC21 N 3148]
TR 9572♦	LOTOS Description of the Session Protocol, January 1989 [SC21 N 3149]
DIS 10168-1♦	Conformance Test Suite for the Session Protocol - Part 1: Test Suite Structure and Test Purposes, 19 April 1990 [SC21 N 4159, 11 December 1989] (IS text expected June 1991)
WD 10168-2♦	Conformance Test Suite for the Session Protocol - Part 2: Generic Test Suite, 1989 (CD text expected June 1992)
WD 10168-3♦	Conformance Test Suite for the Session Protocol - Part 3: Abstract Test Suite for CS Method, 1989 (formal WD text expected February 1991, CD text June 1991)
DIS 10168-4♦	Conformance Test Suite for the Session Protocol - Part 4: Session Test Management Protocol Specification, July 1990 [SC21 N 5026] (IS text expected June 1991)
CCITT X.215	Session Service Definition for OSI for CCITT Applications

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[26] The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

[27] WDAM: Working Draft Amendment for ISO.

B. CONNECTION-ORIENTED SERVICE:

ISO 8327♦	Basic Connection-Oriented Session Protocol Specification, August 1987 (draft revised text of April 1990 incorporates AD1 and AD2); Technical Corrigendum, April 1990
AD 1♦	Session Symmetric Synchronization for the Session Protocol, October 1989 [SC21 N 3508]
AD 2♦	Incorporation of Unlimited User Data, June 1988 [SC21 N 2494]
WDAM 4	Additional Resynchronization Functionality, July 1990 [SC21 N 5041] (CD text expected October 1990)
CD 8327-2♦	Basic Connection-Oriented Session Protocol Specification - Part 2: PICS Proforma, July 1990 [SC21 N 5022] (DIS text expected November 1990, IS text November 1991)
CCITT X.225	Session Protocol Specification for OSI for CCITT Application

C. CONNECTIONLESS SERVICE:

ISO 9548♦	Session Connectionless Protocol to Provide Connectionless-Mode Session Service
CD 9548-2	Session Connectionless Protocol to Provide Connectionless-Mode Session Service - Part 2: PICS Proforma, July 1990 [SC21 N 5022] (DIS text expected November 1990, IS text November 1991)
ISO 8326 AD 3♦	Basic Connection-Oriented Session Service Definition, Connectionless-Mode Session Service, August 1989 [SC21 N 3462]

D. TELEMATIC SERVICES:

CCITT T.5♦	General Aspects of Group 4 Facsimile Apparatus
CCITT T.62♦	Control Procedures for Teletex and Group 4 Facsimile Services
CCITT X.3♦	Packet Assembly/Disassembly Facility (PAD) in a Public Data Network (PDN), 1988.
CCITT X.20♦	Interface Between DTE and DCE for Start-Stop Transmission Services on Public Data Networks, 1988
CCITT X.28♦	DTE/DCE Interface for a Start/Stop Mode DTE Accessing the PAD in a PDN Situated in the Same Directory (Country), 1988
CCITT X.29♦	Procedures for the Exchange of Control Information and User Data Between a PAD and a Packet Mode DTE or Another PAD, 1988

VII. LAYER 6: PRESENTATION LAYER[28]

A. GENERAL:

STANAG 4256♦	Presentation Layer Service Definition, Draft, January 1990	
STANAG 4266♦	Presentation Layer Protocol Specification, Draft, January 1990	
ISO 8822♦	Connection-Oriented Presentation Service Definition, August 1988	
	AD 1♦	Connectionless-Mode Presentation Service, July 1990 [SC21 N 4933]
	WDAM 2♦	Support of Session Symmetric Synchronization Service, February 1990 (CD text expected September 1990)
	CDAM 3	Unlimited User Data, July 1990 [SC21 N 5065] (DIS text expected June 1991, IS text in June 1992)
	CDAM 4	Abstract Syntax Registration, July 1990 [SC21 N 5067] (DIS text expected June 1991, IS text in June 1992)
	WDAM 5	Confidentiality and Integrity, July 1990 [SC21 N 3164] (CD text expected June 1991)
	WDAM 6	Additional Resynchronization Functionality, January 1990 [SC21 N 4121] (CD text expected October 1990)
ISO 8823♦	Connection-Oriented Presentation Protocol Specification	
	WDAM 2♦	Support of Session Symmetric Synchronization Service, February 1990 (CD text expected September 1990)
	CDAM 3	Unlimited User Data, July 1990 [SC21 N 5065] (DIS text expected June 1991, IS text in June 1992)
	CDAM 4	Transfer Syntax Registration, July 1990 [SC21 N 5068] (DIS text expected June 1991, IS text in June 1992)
	WDAM 5	Confidentiality and Integrity, July 1990 [SC21 N 3164] (CD text expected June 1991)
	WDAM 6	Additional Resynchronization Functionality, January 1990 [SC21 N 4121] (CD text expected October 1990)
DIS 8823-2	Connection-Oriented Presentation Protocol Specification - Part 2: PICS Proforma, July 1990 [SC21 N 5025] (IS text expected November 1991)	
CD xxxx-1♦	Conformance Test Suite for the Presentation Protocol, Part 1: Test Suite Structure and Test Purposes, SC21/WG6, July 1990 [SC21 N 5019] (DIS text expected in November 1990, IS text November 1991)	
WD xxxx-2♦	Conformance Test Suite for the Presentation Protocol, Part 2: Test Suite Structure and Test Purposes for ASN.1 Encodings, SC21/WG6, July 1990 [SC21 N 5019] (CD text expected February 1991, DIS text November 1991, IS text November 1992)	

[28] The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

CCITT X.216	Presentation Service Definition for OSI for CCITT Applications (see ISO 8822, 1988)
CCITT X.226	Presentation Protocol Specification for OSI for CCITT Application, (see ISO 8823, 1988)

B. CONNECTIONLESS SERVICE:

ISO 8822 AD 1♦	Connection-Oriented Presentation Service Definition - Connectionless-Mode Presentation Service, July 1990 [SC21 N 4933]
ISO 9576♦	Presentation Connectionless Protocol to Provide Connectionless-Mode Presentation Service, July 1990 [SC21 N 4934]
CD 9576–2	Presentation Connectionless Protocol to Provide Connectionless-Mode Presentation Service - Part 2: PICS Proforma, July 1990 [SC21 N 5020] (DIS text expected November 1990, IS text November 1991)

C. ABSTRACT SYNTAX NOTATION ONE (ASN.1):

STANAG 4258♦	Specification of ASN.1, Draft, January 1990
STANAG 4259♦	Specification of Basic Encoding Rules for ASN.1, Draft, January 1990
ISO 8824♦	Specification of ASN.1, December 1987; Revised text of April 1990 incorporates AM1 on ASN.1 Extensions [SC21 N 4720]
	DAM 1♦ ASN.1 Extensions, June 1988 (incorporated in Revised Edition of ISO 8824)
	WDAM 2 New Features, July 1989 [SC21 N 3165) (CD text expected June 1991)
ISO 8825♦	Specification of Basic Encoding Rules for ASN.1, November 1987; Revised text of April 1990 incorporates AM1 on ASN.1 Extensions [SC21 N 4721]
	DAM 1♦ ASN.1 Extensions, June 1988 (incorporated in Revised Edition of ISO 8825)
	WDAM 2 New Features, July 1989 [SC21 N 3165) (CD text expected June 1991)
WD 8825-2	Conformance Test Suite for the Presentation Protocol - Part 2: Test Suite Structure and Test Purposes for ASN.1 Encodings, July 1990 [SC21 N 5019 (WG6)] (CD text expected February 1991)
SC21 N 3174	Working Document on ASN.1, Including Timetable, March 1989 [SC21/WG6]
CCITT X.208	Specification of Abstract Syntax Notation One (ASN.1) (see ISO 8824, Revised Edition)
CCITT X.209	Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1) (see ISO 8825, Revised Edition)

D. TELEMATIC SERVICES:

CCITT T.6♦	Facsimile (FAX) coding schemes and coding control functions for Group 4 Facsimile Apparatus
CCITT T.51♦	Coded Character Sets for Telematic Services
CCITT T.61♦	Character Repertoire and Coded Character Sets for the International Teletex Service
CCITT T.73♦	Document Interchange Protocol for the Telematic Services

VIII. LAYER 7: APPLICATION LAYER[29]

A. GENERAL:

STANAGs♦	[Separate Application Layer STANAGs will be developed for each application; each will contain the service definition, the protocol specification, and an interoperability profile.][30]
ISO 9545♦	Application Layer Structure (ALS), December 1989 [SC21 N 3825, August 1989]
	WDAD 1♦ Connectionless Mode Transmission, June 1988 [SC21 N 2470] (CD text expected June 1991)
	WDAD 2 Extended Application Layer Structure (XALS), July 1990 [SC21 N 5012] (CD text expected November 1990)
WD xxxx	Service and Protocol for Authentication Exchange Application Service Element (ASE), January 1990 [SC21 N 4110] (CD expected May 1991)
CDTR xxxx	Methodology and Guidelines for the Development of Application Layer Protocols, June 1990 [SC21 N 4903] (new work item of June 1988 failed but programme of work with CDTR is still active; status uncertain)
SC21 N 3109	Architectural and Descriptive Issues Identified During the Workshop on Application Layer Standardization, December 1988 [SC21/WG1]
SC21 N 3208	Requirements for More Efficient Use of Application Associations, December 1988 [SC21/WG6]
SC21 N 3209	Upper Layer Security Model, July 1989 (CD expected June 1991)
SC21 N 3733	Access Control for OSI Applications, July 1989
SC21 N 4002	Extended Application Layer Structure, ANSI Contribution to SC21/WG6, 19 October 1989
SC21 N 4107	Modelling for Communications Aspects of Distributed Applications, January 1990 (new work item; CD text expected June 1991)
SC21 N 4108	Management Information in the Upper Layers, January 1990 (CD expected June 1991)
SC21 N 4354	Topics Proposed for Discussion at the JTC1 Workshop on Distributed Applications, Phoenix, March 1990, UK Contribution, January 1990
SC21 N 4519	Clarification of ALS Modelling Concepts, Workshop on Distributed Applications, 18 April 1990
SC21 N 4520	Issues for Consideration by Joint ULA/ODP Meeting, Seoul, May/June 1990, Workshop on Distributed Applications, 18 April 1990
SC21 N 4674	Liaison Statement Regarding Common Application Interfaces for the Telematic Services, CCITT SG I, 23 May 1990
SC21 N 4764	Progression of Association Pools, ANSI, 9 May 1990

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29 The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

30 *NTIS Transition Strategy* [Ref. 4], p.3.

SC21 N 4766	US Response to SC21/WG6 N 770 on Requirements for Extended ALS, ANSI, May 1990
SC21 N 4904	Request for Comment on Characteristics of an Application Service Element and Application Service Object, SC21/WG6, May 1990
SC21 N 4905	Request for Comment on Introduction of a New Relationship in ALS, SC21/WG6, June 1990
SC21 N 4908	Liaison to CCITT SG VII(Q19,Q25) on ULA Topics, SC21/WG6, June 1990
SC21 N 4926	Liaison to CCITT SG VII(Q19) on DAF, SC21/WG6, June 1990
SC21 N 5003	Distributed Applications Security Modelling and Infrastructure, SC21/WG6, July 1991
SC21 N 5011	Modelling Recovery in the Application Layer, SC21/WG6, 1 June 1990 (new work item; CD text expected June 1991)
SC21 N 5016	Meeting Report for SC21/WG1/WG4/WG6/WG7 Joint Meeting on Service Conventions, ODP, and ULA on 29 May 1990, SC21, June 1990

B. OSI DIRECTORY:

ISO 9594-1♦	The Directory - Part 1: Overview of Concepts, Models, and Service
ISO 9594-1/7♦	Amendments to Parts 1-7, Support of Nameform2 (formal WD text planned for June 1991, CD text in November 1991, DIS text in November 1992, and IS text in November 1993)
ISO 9594-1/7♦	Amendments to Parts 1-7, Schema, PCDAMs, July 1990 [SC21 N 4914] (CD text planned for October 1990, DIS text in October 1991, and IS text in October 1992)
ISO 9594-2♦	The Directory - Part 2: Models
ISO 9594-2/5♦	Amendments to Parts 2-5, Access Control, PDAMs, December 1989 [SC21 N 4041] (DIS text for June 1991 and IS text in June 1992)
ISO 9594-2/5♦	Amendments to Parts 2-5, Replication and Knowledge Management, PCDAMs, July 1990 [SC21 N 4913] (CD text planned for October 1990, DIS text in October 1991, and IS text in October 1992)
ISO 9594-3♦	The Directory - Part 3: Abstract Service Definitions
ISO 9594-3/4	Amendments to Parts 3,4, Enhanced Search, PCDAMs, July 1990 [SC21 N 4924] (CD text planned for October 1990, DIS text in October 1991, and IS text in October 1992)
ISO 9594-4♦	The Directory - Part 4: Procedures for Distributed Operations
ISO 9594-5♦	The Directory - Part 5: Protocol Specifications
ISO 9594-6♦	The Directory - Part 6: Selected Attribute Types
ISO 9594-7♦	The Directory - Part 7: Selected Object Classes
ISO 9594-8♦	The Directory - Part 8: Authentication Framework
WD 9594-9♦	The Directory - Part 9: DIT Structure and Naming, July 1990 [SC21 N 4985] (CD text expected October 1990, DIS text in October 1991, IS text in October 1992)
WD 9594-10♦	The Directory - Part 10: Replication and Knowledge Management, July 1990 [SC21 N 4913] (CD text expected October 1990, DIS text in October 1991, IS text in October 1992)

WD 9594-11♦	The Directory - Part 11: Directory PICS Proforma, July 1989 [SC21 N 4039] (CD text expected November 1991)
WD 9594-X♦	The Directory - Part X: Text Suite Structure and Test Purposes, July 1990 [SC21 N 4951] (CD text expected 1992)
WD 9594-Y♦	The Directory - Part Y: Abstract Test Suite for the OSI Directory, July 1990 [SC21 N 4951] (CD text expected 1992)
SC21 N 4799	Letter for Information on Disposition of EDIMS Use of Directory, 21 May 1990
SC21 N 4803	Publication of Directory Schema and Other Registered Object Definitions, Canada, 2 May 1990
SC21 N 4804	Proposed DIT Structure Rule Definition, 10 May 1990
SC21 N 4806	Use of External Data Transfer Systems for Shadow Updates, 10 May 1990
SC21 N 4918	Question on Standardization of Directory API, July 1990
SC21 N 4922	Information on Distributed Entries, SC21/WG4, July 1990
SC21 N 4924	Extensions to Directory Abstract Service, Working Draft, SC21/WG4, July 1990
SC21 N 4951	Test Suites for OSI Directory, SC21/WG4, July 1990 (new work item)
CCITT X.500	The Directory - Overview of Concepts, Models, and Services
CCITT X.501	The Directory - Models
CCITT X.509	The Directory - Authentication Framework
CCITT X.511	The Directory - Abstract Service Definition
CCITT X.518	The Directory - Procedures for Distributed Operation
CCITT X.519	The Directory - Protocol Specifications
CCITT X.520	The Directory - Selected Attribute Types
CCITT X.521	The Directory - Selected Object Classes

C. OPERATING SYSTEM INTERFACE:

ISO 9945-1	Portable Operating System Interface for Computer Environments (POSIX) - Part 1: System Interface, 1990
DP 9945-2	POSIX - Part 2: Shell and Utilities, 1989
DP xxxx♦	Operating System Command and Response Language (OSCRL)
DP xxxx♦	System Software Interface for Application Programmes (SSI)

D. ASSOCIATION CONTROL SERVICE ELEMENT (ACSE):

ISO 8649♦ Service Definition for the ACSE (equivalent to CCITT X.217)

DAD 1♦	Peer-Entity Authentication During Association Establishment, September 1989 [SC21 N 3771] (editing meeting July 1990)
AM 2♦	Connectionless-Mode ACSE Service, April 1989 [SC21 N 3458]
WDAD 3♦	Application Context Management (CD text expected October 1991)

ISO 8650♦	Protocol Specification for the ACSE (equivalent to CCITT X.227); Technical Corrigendum, 1 June 1990
	DAD 1♦ Peer-Entity Authentication During Association Establishment, September 1989 [SC21 N 3772] (editing meeting July 1990)
	WDAD 3♦ Application Context Management (CD text expected October 1991)
	WDAD 4 Application Entity Titles
DIS 8650-2	ACSE PICS Proforma, July 1990 [SC21 N 5024] (IS text expected June 1991)
ISO 10035♦	Connectionless ACSE Protocol Specification, July 1990 [SC21 N 3456]
WD 10035-2	Connectionless ACSE Protocol Specification - Part 2: PICS Proforma for Connectionless ACSE Protocol, July 1989 [SC21 N 3218] (CD text possible in June 1991)
DIS 10169-1♦	Conformance Test Suite for the ACSE Protocol - Part 1: Test Suite Structure and Test Purposes, February 1989 [SC21 N 3219] (IS text expected June 1991)
CCITT X.217	Association Control Service Definition for OSI for CCITT Applications (see ISO 8649)
CCITT X.227	Association Control Protocol Specification for OSI for CCITT Applications (see ISO 8650)

E. COMMITMENT, CONCURRENCY, AND RECOVERY (CCR) SERVICE ELEMENT:

ISO 9804♦	Service Definition for the Commitment, Concurrency, and Recovery (CCR) Service Element Service, April 1990 [SC21 N 4611] (CCITT X.237)
	CDAD 1♦ Enhancements, July 1990 [SC21 N 4615] (DIS text expected May 1991, IS text in May 1992)
	WDAD 2♦ Session Mapping Changes (Additional Resynchronization Functionality), July 1990 [SC21 N 5122] (CD text expected November 1990)
	WDAD 3♦ Restart (CD text expected May 1992)
ISO 9805♦	Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Service Element Protocol, April 1990 [SC21 N 4612] (CCITT X.247)
	CDAD 1♦ Enhancements, July 1990 [SC21 N 4616] (DIS text expected May 1991, IS text in May 1992)
	WDAD 2♦ Session Mapping Changes (Additional Resynchronization Functionality), July 1990 [SC21 N 5123] (CD text expected November 1990)
	WDAD 3♦ Restart (CD text expected May 1992)
CD 9805-2♦	Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Service Element Protocol - Part 2: PICS Proforma, July 1990 [SC21 N 5121] (DIS text expected November 1991, IS text in November 1992)
SC21 N 3180	Possible CCR Extensions - Base Text, January 1989 [SC21/WG6]
SC21 N 4279	CCR Conformance Test Suite, January 1990 (CD text expected June 1993)

F. RELIABLE TRANSFER (RT), REMOTE OPERATIONS (RO), AND REMOTE PROCEDURE CALL (RPC):

ISO 9066-1.2♦	Reliable Transfer - Part 1: Model, Notation and Service Definition
ISO 9066-2.2♦	Reliable Transfer - Part 2: Protocol Specification
ISO 9072-1.2♦	Remote Operations - Part 1: Concepts and Model
ISO 9072-2.2♦	Remote Operations - Part 1: Protocol Specification
DIS 10148	Basic Remote Procedure Call (RPC) Using OSI Remote Operations, [SC21 N 3463; fast-track ballot failed; DIS 10148 WITHDRAWN; proposal for new work item, SC21 N 4153, January 1990] (CD text for RPC model, service, and protocol now planned for June 1991)
SC21 N 4523	Modelling of Application Program Interfaces and Remote Procedure Calls, Distributed Applications Workshop, 2 April 1990
SC21 N 4767	US Response to SC21/WG6 N 7889 on Requirements for RPC Interface Definition Notation, 11 May 1990
SC21 N 4925	Liaison to SC22/WG11 Concerning Remote Procedure Call Interface Definition Notation (IDN), June 1990
SC21 N 4927	Remote Procedure Call, Working Draft, SC21/WG6, 1 June 1990
SC21 N 4928	Remote Procedure Call Definitions and Requirements, SC21/WG6, June 1990
CCITT X.218	Reliable Transfer: Model and Service Definition (see ISO 9066-1)
CCITT X.219	Remote Operations: Model, Notation and Service Definition (see ISO 9072-1)

G. MESSAGE HANDLING SYSTEM (MHS):

STANAG 4257♦	Military Message Handling System (MMHS), Draft, May 1990
CCITT X.218	Reliable Transfer: Model and Service Definition (see ISO 9066-1)
CCITT X.219	Remote Operations: Model and Service Definition (see ISO 9072-1)
CCITT X.228	Reliable Transfer: Protocol Specification (see ISO 9066-2)
CCITT X.229	Remote Operations: Protocol Specification (see ISO 9072-2)
CCITT X.400♦	Message Handling Systems (MHSs): System Model - Service Elements (see ISO 10021-1 for MOTIS)
CCITT X.401♦	MHSs - Basic Service Elements and Optional User Facilities
CCITT X.402♦	MHSs: Overall Architecture (ISO 10021-2, MOTIS)
CCITT X.403♦	MHSs: Conformance Testing
CCITT X.407♦	MHSs - Abstract Service Definition Conventions (ISO 10021-3, MOTIS)
CCITT X.408♦	MHSs - Encoded Information-Type Conversion Rules
CCITT X.409♦	MHSs - Presentation Transfer Syntax and Notation [replaced by X.208 (ISO 8824 with DAD1) and X.208 (ISO 8825 with DAD1)]
CCITT X.410♦	MHSs - Remote Operations and Reliable Transfer Server [replaced by X.218 (ISO 9066-1), X.219 (ISO 9072-1), X.228 (ISO 9066-2), and X.229 (ISO 9072-2)]
CCITT X.411♦	MHSs - Message Transfer Layer (see ISO 10021-4)
CCITT X.413♦	MHSs - Message Store: Abstract Service Definition (ISO 10021-5, MOTIS)

CCITT X.419♦	MHSs: Protocol Specifications (ISO 10021-6, MOTIS)
CCITT X.420♦	MHSs - Interpersonal Messaging User Agent Layer (ISO 10021-7, MOTIS)
CCITT X.430♦	MHSs - Access Protocol for Teletex Terminals
CCITT F.400	Message Handling System and Service Overview
CCITT F.401	Naming and Addressing for Public Message Handling Services
CCITT F.410	The Public Messaging Transfer Service
CCITT F.415	Intercommunication with Public Physical Delivery Services
CCITT F.420	The Public Interpersonal Messaging (IPM) Service
CCITT F.421	Intercommunication Between the IPM Service and the Telex Service
CCITT F.422	Intercommunication Between the IPM Service and the Teletex Service
CCITT F.500	International Public Directory Services

H. MESSAGE ORIENTED TEXT INTERCHANGE SYSTEM (MOTIS):[31]

ISO 10021-1♦	MOTIS - Part 1: System and Service (CCITT X.400)
ISO 10021-2♦	MOTIS - Part 2: Overall Architecture (CCITT X.402)
ISO 10021-3♦	MOTIS - Part 3: Abstract Service Definition Conventions (CCITT X.407)
ISO 10021-4♦	MOTIS - Part 4: Message Transfer System - Abstract Service Definition and Procedures (CCITT X.411)
ISO 10021-5♦	MOTIS - Part 5: Message Store - Abstract Service Definition (CCITT X.413)
ISO 10021-6♦	MOTIS - Part 6: Protocol Specifications (CCITT X.419)
ISO 10021-7♦	MOTIS - Part 7: Interpersonal Message System (CCITT X.420)
DP xxxx	Mailbox Access Service and Protocol

I. MANUFACTURING MESSAGE SPECIFICATION:

DIS 9506-1♦	Manufacturing Message Specification - Part 1: Service Definition
DIS 9506-2♦	Manufacturing Message Specification - Part 2: Protocol Specification

J. FILE TRANSFER, ACCESS AND MANAGEMENT (FTAM):

ISO 8571-1♦	FTAM - Part 1: General Introduction
	DAM 1♦ Filestore Management, July 1990
	PDAM 2♦ Overlapped Access, April 1990
ISO 8571-1/5	Amendments to Parts 1-5: Enhancement to FTAM Services to Satisfy Additional User Requirements, January 1990 (new work item) [SC21 N 4162] (CD text expected May 1991)

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31 DIS 8505♦, DIS 8883♦, and DIS 9065♦ are not included in this list, since they have been superceded by the other standards included in the list (see Section 4.3.1).

ISO 8571-2♦	FTAM - Part 2: Virtual Filestore Definition
	DAM 1♦ Filestore Management, July 1990
	PDAM 2♦ Overlapped Access, April 1990
ISO 8571-3♦	FTAM - Part 3: File Service Definition
	DAM 1♦ Filestore Management, July 1990
	PDAM 2♦ Overlapped Access, April 1990
ISO 8571-4♦	FTAM - Part 4: File Protocol Specification
	DAM 1♦ Filestore Management, July 1990
	PDAM 2♦ Overlapped Access, April 1990
ISO 8571-5♦	FTAM - Part 5: Protocol Implementation Conformance Statement Proforma
	WDAM 1♦ Filestore Management, July 1990
	WDAM 2♦ Overlapped Access, July 1990
DIS 10170-1♦	Conformance Test Suite for the FTAM Protocol - Part 1: Test Suite Structure and Test Purposes, July 1990 [SC21 N 4181, 11 December 1989]
DP 10170-2♦	Conformance Test Suite for the FTAM Protocol - Part 2: FTAM Abstract Test Suite [SC21 N 3665, June 1989] (CD text expected June 1991)
DP 10170-3♦	Conformance Test Suite for the FTAM Protocol - Part 3: ACSE Abstract Test Suite Embedded Under FTAM (CD text expected June 1992)
DP 10170-4♦	Conformance Test Suite for the FTAM Protocol - Part 4: Presentation Abstract Test Suite Embedded Under FTAM (CD text expected June 1992)
DP 10170-5♦	Conformance Test Suite for the FTAM Protocol - Part 5: Session Abstract Test Suite Embedded Under FTAM (CD text expected June 1992)
DISP 10607-1	ISPs - AFT nn - File Transfer, Access, and Management - Part 1: Specification of ACSE, Presentation and Session Protocols for the Use by FTAM, 26 April 1990 [SGFS N 131] (submitted by SPAG)
DISP 10607-2	ISPs - AFT nn - File Transfer, Access, and Management - Part 2: Definition of Document Types, Constraint Sets and Syntaxes, 26 April 1990 [SGFS N 131] (submitted by SPAG)
DISP 10607-3	ISPs - AFT nn - File Transfer, Access, and Management - Part 3: AFT 11 - Simple File Transfer Service (Unstructured), 26 April 1990 [SGFS N 131] (submitted by SPAG)
WDISP 10607-4	ISPs - AFT nn - File Transfer, Access, and Management - Part 4: AFT 12 - Positional File Transfer Service, July 1990
WDISP 10607-5	ISPs - AFT nn - File Transfer, Access, and Management - Part 5: AFT 22 - Positional File Access Service, July 1990
WDISP 10607-6	ISPs - AFT nn - File Transfer, Access, and Management - Part 6: AFT 12 - File Management Service, July 1990
SC2. N 3372	Sharing an Association Between FTAM and Other ASE, February 1989 [SC21/WG5]
SC21 N 4162	Proposal for a NWI for Enhancement of FTAM Services to Satisfy Additional User Requirements, December 1989
SC21 N 4184	Request for National Body Comment on Security Enhancements to FTAM, SC21/WG5, November 1989

SC21 N 4192	Proposed FTAM Document Type to Support CGM, SC21/WG5, December 1989
SC21 N 5155	Enhancement of FTAM Security Services, New Work Item Proposal, SC21/WG5, July 1990
SC21 N 5164	Planned Work Schedule for FTAM, SC21/WG5, June 1990
SC21 N 5165	FTAM Constraint Set and Document Types for CGM, SC21/WG5, June 1990
SC21 N 5189	Liaison Statement to JTC1/SWG-EDI on EDIFACT Document Types for FTAM, SC21/WG5, June 1990

K. VIRTUAL TERMINAL (VT):

ISO 9040♦	Virtual Terminal Service - Base Class (April 1990 Revised Edition incorporates AD1)
	AD 1♦ Extended Facility Set
	DAM 2♦ Additional Functional Units, July 1990 (IS text expected June 1991)
ISO 9041♦	Virtual Terminal Protocol - Basic Class (April 1990 Revised Edition incorporates AD1)
	AD 1♦ Extended Facility Set
	DAM 2♦ Additional Functional Units, June 1990 (IS text expected June 1991)
CD 9041-2♦	Virtual Terminal Protocol - Part 2: PICS Proforma, June 1990 [SC21 N 4175] (DIS text expected January 1991, IS text in January 1992)
SC21 N 3365	Guide to ISO Virtual Terminal Standards, February 1989 [SC21/WG5]
SC21 N 5162	Conformance Test Suite for the VT Protocol, July 1990 (CD text expected December 1990, DIS text in July 1991, IS text in March 1992)

L. TERMINAL MANAGEMENT (TM), VISUAL DISPLAY TERMINAL (VDT), AND X-WINDOWS:

DIS 9241	Visual Display Terminal (VDT) [TC159 SC4/WG5]
CD 10184-1	Terminal Management - Model, June 1990 [SC21 N 4176] (DIS text expected July 1991, IS text in July 1992)
WD 10184-2	Terminal Management - Service, June 1990 [SC21 N 4176] (formal WD text expected November 1990, CD expected November 1991)
WD 10184-3	Terminal Management - Protocol, June 1990 [SC21 N 4176] (formal WD text expected November 1990, CD expected November 1991)
SC21 N 3369	Terminal Management (TM) Issues List, February 1989 [SC21/WG5]
SC21 N 3381	Statement on TM Strategic Direction, February 1989 [SC21/WG5]
SC21 N 3383	Relationship Between TM and User Interfaces, February 1989 [SC21/WG5]
SC21 N 3930	Liaison Statement from JTC1/SC18 to JTC1/SC21/WG5 on Comments on Terminal Management, SC18/WG4, 19 October 1989
SC21 N 4188	Response to SC18/WG4 N 1183, Comments on Terminal Management, and SC18/WG3 and CCITT SG VII(Q27) Liaison Statement on Terminal Management, SC21/WG5, December 1989
SC21 N 4189	Comments on the Integration of X-Windows into the OSI Environment, December 1989

M. JOB TRANSFER AND MANIPULATION (JTM):

ISO 8831♦	Job Transfer and Manipulation Concepts and Services; draft Revised Edition of December 1989 incorporates AD1 [SC21 N 4183]
ISO 8832♦	Specification of the Basic Class Protocol for Job Transfer and Manipulation
DAM 1♦	JTM Full Protocol Specification, 28 May 1990 [SC21 N 5225, text with amendment incorporated; and SC21 N 5224, amendment alone] (IS text expected November 1991)
SC21 N 4603	Position on Reassessment of JTM Full Class Protocol, AFNOR, March 1990
SC21 N 4641	US Position on JTM Reassessment, March 1990
SC21 N 4679	Reassessment of Project 1.21.13.03 (JTM Full Class), SC21, 10 June 1990

N. TELEMATIC SERVICES:

CCITT F.200♦	Teletex Service
CCITT F.200/C♦	Teletex Service, Annex C: Mixed Mode of Operation
CCITT F.201♦	Internetworking Between the Teletex Service and the Telex Service
CCITT T.60♦	Terminal Equipment for Use in the Teletex Service
CCITT T.63♦	Provision for Verification of Teletex Compliance
CCITT T.72♦	Terminal Capabilities for Mixed Mode of Operation
CCITT T.90♦	Teletex Requirements for Internetworking with the Telex Service
CCITT T.91♦	Teletex Requirements for Real-Time Internetworking with the Telex Service in a Packet-Switched Network Environment
CCITT T.330♦	Telematic Access to Interpersonal Messaging System
CCITT X.430♦	MHS, Access Protocol for Teletex Terminals

O. INFORMATION RESOURCE DICTIONARY SYSTEM (IRDS):

DP 8800-1	Information Resource Dictionary System (IRDS) - Part 1: Command Language and Panel Interface, April 1987 [SC21 N 1789] (projected suspended until the IRDS services interface reaches DIS status; the command language and panel interface are expected to be split into separate standards)
ISO 10027♦	IRDS Framework, March 1989 [SC21 N 3426]
WD xxxx	IRDS - Service Interface, July 1990 [SC21 N 5147] (CD text expected January 1991)
WD xxxx	IRDS - Design Support for SQL Applications (CD text expected January 1991)
WD xxxx	IRDS - Export/Import (CD text expected November 1990)
WD xxxx	IRDS - Extensions, July 1990 [SC21 N 5139] (CD text expected June 1992)
SC21 N 3344	IRDS Rapporteur Group Position on Need for IRDS Specialization for RDA, April 1989 [SC21/WG3]
SC21 N 4806	Use of External Data Transfer Systems for Shadow Updates, 10 May 1990

SC21 N 5137	Data Management Export/Import for SQL and IRDS, SC21/WG3, July 1990 (new work item)
SC21 N 5139	IRDS Extensions, SC21/WG3, July 1990 (new work item)

P. REMOTE DATABASE ACCESS (RDA):

DP 9579-1♦	Remote Database Access (RDA) - Part 1: Generic Model, Service, and Protocol, March 1990 [SC21 N 4282] (CD text expected June 1991)
DP 9579-2♦	Remote Database Access (RDA) - Part 2: SQL Specialization, March 1990 [SC21 N 4281]
WDAM 1	Support for SQL2, March 1990 (CD text expected June 1992)
WDTR xxxx♦	Remote Database Access Tutorial, January 1989 [SC21 N 3343] (CD text expected June 1991)
SC21 N 3344	IRDS Rapporteur Group Position on Need for IRDS Specialization for RDA, April 1989 [SC21/WG3]
SC21 N 3346	RDA Use of Remote Operation Notation of ROSE, December 1988 [SC21/WG3]
SC21 N 3351	RDA Requirements for CCR, December 1988 [SC21/WG3]
SC21 N 3352	Harmonization of RDA and TP, December 1988 [SC21/WG3]
SC21 N 5138	RDA Support for Shared DBL Statements, July 1990 (new work item; rapporteur meeting January 1991)

Q. DATA MANAGEMENT CONCEPTS:

TR 9007	Concepts and Terminology for the Conceptual Schema and the Information Base
CD 10032.2♦	Reference Model of Data Management, Revised Draft, July 1990 [SC21 N 2641, May 1988] (editing meeting scheduled January 1991)
WDTR xxxx	Tutorial on the Reference Model for Data Management (CDTR expected June 1992)
SC21 N 197	Concepts and Terminology for the Conceptual Schema and the Information Base, TC97/SC5, March 1982
SC21 N 236	Assessment Guidelines for Conceptual Schema Language Proposals, TC97/SC21/WG5-3, 31 August 1985
SC21 N 3358	Generic Data Management Export/Import
SC21 N 3806	Request for New Question on Conceptual Schema Standardization, September 1989
SC21 N 3903	Modelling, Specification, Use, and Role of Conceptual Schemas, October 1989
SC21 N 4195	Draft WG3 Position on Conceptual Schema Question, February 1990
SC21 N 4199	Liaison Statement to JTC1/SC1 on SC21/WG3 Terminology, contains the Reference Model on Data Management (8 August 1989), February 1990
SC21 N 4280	Proposed New Work Item: Conceptual Data Modelling Facility, SC21/WG3, February 1990
SC21 N 4383	Development of the Extended Information Model, January 1990
SC21 N 4511	US Comments on Conceptual Schema, ANSI, 15 March 1990
SC21 N 4524	Consideration of the Data Management Component of Application Standards, Workshop of Distributed Applications, 23 April 1990

SC21 N 4593	Metadata Use and Standards for Managing Metadata, ANSI, 4 April 1990
SC21 N 5137	Data Management Export/Import for SQL and IRDS, SC21/WG3, July 1990 (new work item)
SC21 N 5193	Conceptual Schema HOD/C Meeting report Held on 31 May 1990 in Seoul, July 1990

R. DATABASE LANGUAGES AND CONCEPTS:

ISO 8907♦	Database Language NDL, June 1987
ISO 9075♦	Database Language SQL, April 1989 (incorporates AD 1) [SC21 N 3158]
	AD 1♦ Integrity Enhancements
CD 9075.2♦	Database Language SQL2, July 1990 [SC21 N 3155, 25 January 1989]
WD 9075.3♦	Database Language SQL3 (CD expected June 1992)
SC21 N 3158	Database Language SQL2 With Integrity Enhancement, January 1989 [SC21/WG3]
SC21 N 4875	Recommendation on SQL2 Progress ISO 9075 Revised, 31 May 1990
SC21 N 5137	Data Management Export/Import for SQL and IRDS, SC21/WG3, July 1990 (new work item)

S. DISTRIBUTED TRANSACTION PROCESSING (TP):

DIS 10026-1♦	Distributed Transaction Processing (TP) - Part 1: Model, 22 March 1990 [SC21 N 4288, 15 December 1989] (IS text expected June 1992)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Transaction Processing Security, WDAMs, January 1990 [SC21 N 4163] (CD text expected June 1991)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Transaction Processing Association Management, WDAMs, January 1990 [SC21 N 4164] (CD text expected June 1992)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Transaction Processing Heuristic Decisions, WDAMs, January 1990 [SC21 N 4167]
DIS 10026-1/3	Draft Amendments to Parts 1-3: Transaction Processing Commitment Optimization, WDAMs, January 1990 [SC21 N 4168] (IS text expected June 1991)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Distributed Transaction Processing Dialogue Recovery and User Suspension of a Dialogue, WDAMs, January 1990 [SC21 N 4170] (CD text expected June 1992)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Distributed Transaction Processing Savepoints, January 1990 [SC21 N 4171] (new work item; not accepted by JTC1, June 1990)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Transaction Processing Sub-Transactions, WDAMs, July 1990 [SC21 N 5156] (CD text expected January 1992)
DIS 10026-1/4	Draft Amendments to Parts 1-3: Transaction Processing Separate Data and Commit Associations, WDAMs, July 1990 [SC21 N 5156] (CD text expected May 1993)
DIS 10026-2♦	Distributed Transaction Processing (TP) - Part 2: Service Definition, 22 March 1990 [SC21 N 4290] (IS text expected June 1991)

DIS 10026-3♦	Distributed Transaction Processing (TP) - Part 3: Transaction Processing Protocol Specification, 22 March 1990 [SC21 N 4292] (IS text expected June 1991)
CD 10026-4	Distributed Transaction Processing (TP) - Part 4: PICS Proforma, July 1990 [SC21 N 5159] (editing meeting scheduled January 1991)
CD 10026-5	Distributed Transaction Processing (TP) - Part 5: Application Context Proforma, July 1990 [SC21 N 5160]
WD 10026-Y	Data Transfer for OSI TP - Unstructured Data Transfer, January 1990 [SC21 N 4166] (new work item; CD text expected June 1991)
WD 10026-Z	Data Transfer for OSI TP - Other Transfer Modes, January 1990 [SC21 N 4166] (new work item; CD text expected June 1992)
WD xxxx-1	Conformance Test Suite for the TP Protocol, Part 1: Test Suite Structure and Test Purposes, 6th Working Draft, June 1990 [SC21 N 5162] (formal WD text expected February 1991, CD text June 1992)
WD xxxx-2	Conformance Test Suite for the TP Protocol, Part 2: Abstract Test Suites, January 1990 [SC21 N 4172]
SC21 N 4186	TP: Request for Comments on Sub-Transactions, November 1989
SC21 N 5156	TP Sub-Transactions, New Work Item Proposal, SC21/WG5, July 1990
SC21 N 5157	TP Separate Data and Commit Associations, New Work Item Proposal, SC21/WG5, July 1990
SC21 N 5169	Plan for OSI TP DIS Editing, SC21/WG5, June 1990 (editing meetings on DIS text planned for Nov-Dec 1990, Mar-Apr 1991, and May 1991)
SC21 N 5170	OSI TP Association Management - Statement of Requirements, SC21/WG5, June 1990
SC21 N 5171	OSI TP Security - Statement of Requirements, SC21/WG5, June 1990
SC21 N 5172	Combined Use of RPC and OSI TP, SC21/WG5, June 1990
SC21 N 5173	Working Draft Unstructured Data Transfer (UDT) for TP, SC21/WG5, May 1990
SC21 N 5176	OSI TP Security, New Work Item, June 1990
SC21 N 5177	OSI TP Association Management - Revised New Work Item, SC21/WG5, June 1990
SC21 N 5179	Proposed Replacement Text for the NWI Proposal on Commitment Optimizations in SC21 N 4168 (JTC1 N 631), SC21/WG5, June 1990
SC21 N 5183	Combined Use of CMISE and OSI TP, SC21/WG5, June 1990
SC21 N 5184	Queued Data Transfer for TP, SC21/WG5, May 1990

T. OPEN DISTRIBUTED PROCESSING (ODP):

CD xxxx-1♦	Basic Reference Model for Open Distributed Processing - Part 1: Introduction (proposal for new work item, 1987) [SC21 N 1547] (CD text expected June 1994)
CD xxxx-2♦	Basic Reference Model for Open Distributed Processing - Part 2: Concepts and Modelling Tools (proposal for new work item, 1987) [SC21 N 1547] (CD text expected June 1992)
CD xxxx-3♦	Basic Reference Model for Open Distributed Processing - Part 3: Framework for ODP Standards (proposal for new work item, 1987) [SC21 N 1547] (CD text expected May 1993)

CD xxxx-4♦	Basic Reference Model for Open Distributed Processing - Part 4: User Guide (proposal for new work item, 1987) [SC21 N 1547] (CD text expected May 1994)
SC21 N 1889	ODP: Proposed Revised Text for the NWI on the Basic Reference Model of Open Distributed Processing, 29 April 1987
SC21 N 2507	ODP: Report on Topic 1 - The Problem of Distributed Processing, March 1988 [SC21/WG7]
SC21 N 2511	ODP: Definitions and Glossary - March 1988 Version, March 1988 [SC21/WG7]
SC21 N 3194	ODP: Working Document on Topic 2.3 - Framework of Abstractions, December 1988 [SC21/WG7]
SC21 N 3202	ODP: Recommendations of SC21/WG7, Sydney, 9 December 1988
SC21 N 3288	ODP: Working Document on Topic 2.2 - Properties and Design Freedoms, December 1988 [SC21/WG7]
SC21 N 3801	Support Environment for Open Distributed Processing, ECMA, September 1989
SC21 N 4019	ODP: Topics List - November 1989 Version - for the Basic Reference Model of Open Distributed Processing, 8 November 1989
SC21 N 4020	ODP: List of Open and Resolved Issues - November 1989 Version, 11 December 1989
SC21 N 4021	ODP: Document Register and Bibliography - November 1989 Version, 11 December 1989
SC21 N 4022	ODP: Working Document on Topic 4.1 - Structrures and Functions, 11 December 1989
SC21 N 4023	ODP: Working Document on Topic 6.1 - Modelling Techniques and Their Use in ODP, 11 December 1989
SC21 N 4024	ODP: Working Document on Topic 6.2 - Formalisms and Specifications, 11 December 1989
SC21 N 4025	ODP: Working Document on Topic 8.1 - Draft Basic Reference Model of Open Distributed Processing, 11 December 1989
SC21 N 4026	ODP: Recommendations of SC21/WG7, Florence, 11 December 1989
SC21 N 4027	ODP: Meeting Minutes of the Florence Working Group Meeting of WG7, 11 December 1989
SC21 N 4028	ODP: SC21/WG7 Convener's Report to SC21 Plenary Meeting, 11 December 1989
SC21 N 4029	ODP: Liaison Statement to JTC1/TSG-1 on IAP, 11 December 1989
SC21 N 4030	ODP: Cooperation between SC21/WG7 and CCITT SG VII (Q19/DAF), 11 December 1989
SC21 N 4031	ODP: Session Report on Joint Meeting on FDT, 11 December 1989
SC21 N 4032	ODP: Liaison Statement to JTC1/SWG-EDI on EDI Modelling, 11 December 1989
SC21 N 4033	ODP: Proposal for Future Cooperation Between SC21/WG6 and SC21/WG7 on ULA and ODP, 11 December 1989
SC21 N 4564	ODP: Liaison Statement to SC21/WG7 on Relationship of DAF Architecture/Infrastructure with ODP Topic 4 - Functions and Interfaces, CCITT SG VII, March 1990
SC21 N 4655	Architectural Semantics for ODP - Reassessment Report, SC21/WG7, April 1990

U. GRAPHICAL KERNEL SYSTEM (GKS):

ISO 7942	Graphical Kernel System (GKS) Functional Description
	DAD 1 Audit Trail Metafile
ISO 8651-1	GKS Language Bindings - Part 1: FORTRAN
ISO 8651-2	GKS Language Bindings - Part 2: Pascal
ISO 8651-3	GKS Language Bindings - Part 3: Ada
WD 8651-4	GKS Language Bindings - Part 4: C
ISO 8805	GKS for Three Dimensions (GKS-3D) Functional Description
	WDAD 1 Name Set Addendum
DIS 8806-1	GKS-3D Language Bindings - Part 1: FORTRAN
DIS 8806-3	GKS-3D Language Bindings - Part 3: Ada
DIS 8806-4	GKS-3D Language Bindings - Part 4: C

V. PROGRAMMER'S HIERARCHICAL INTERACTIVE GRAPHICS SYSTEM (PHIGS):

ISO 9592-1	Programmer's Hierarchical Interactive Graphics System (PHIGS) Language Bindings - Part 1: Functional Description
ISO 9592-2	PHIGS Language Bindings - Part 2: Archive File Format
ISO 9592-3	PHIGS Language Bindings - Part 3: Clear-Text Encoding of Archive File
ISO 9593-1	PHIGS Language Bindings - Part 1: FORTRAN Binding
DIS 9593-2	PHIGS Language Bindings - Part 2: Extended Pascal
DIS 9593-3	PHIGS Language Bindings - Part 3: Ada
DIS 9593-4	PHIGS Language Bindings - Part 4: C
SC24 N 224	PHIGS Plus, 1989

W. DIALOGUES WITH GRAPHICAL DEVICES:

DP 9636-1	Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 1: Overview, Profiles, and Conformance
DP 9636-2	Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 2: Control, Negotiation, and Errors
DP 9636-3	Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 3: Output and Attributes
DP 9636-4	Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 4: Segmentation
DP 9636-5	Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 5: Input and Echoing
DP 9636-6	Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 6: Raster
WD 9636-8	Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 8: FORTRAN Language Binding of CGI
WD 9636-11	Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 11: C Language Binding of CGI

X. DOCUMENT EXCHANGE--ODA, ODIF, DOAM, DFR, AND DTAM:

ISO 8211	Specification for a Data Descriptive File for Information Interchange
ISO 8613-1♦	Office Document Architecture (ODA) and Interchange Format - Part 1: Introduction and General Principles
ISO 8613-2♦	ODA and Interchange Format - Part 2: Document Structures
	PDAD 1 Formal Specification of ODA Document Structures
ISO 8613-3♦	ODA and Interchange Format - Part 3: Document Processing Reference Model
ISO 8613-4♦	ODA and Interchange Format - Part 4: Document Profile
ISO 8613-5♦	ODA and Interchange Format - Part 5: Office Document Interchange Format (ODIF)
ISO 8613-6♦	ODA and Interchange Format - Part 6: Character Content Architectures
ISO 8613-7♦	ODA and Interchange Format - Part 7: Raster Graphics Content Architectures
ISO 8613-8♦	ODA and Interchange Format - Part 8: Geometric Graphics Content Architectures
DIS 10031-1	Distributed Office Applications Model (DOAM) - Part 1: General Model
DIS 10031-2	Distributed Office Applications Model (DOAM) - Part 2: Referenced Data
DIS 10166-1	Document Filing and Retrieval (DFR) - Part 1: Abstract Service Definition and Procedures, 14 December 1989 [SC18 N 2069, February 1989]
DIS 10166-2	Document Filing and Retrieval (DFR) - Part 2: Protocol Specification, 14 December 1989 [SC18 N 2070, February 1989]
SC21 N 4472	Liaison Statement from JTC1/SC18 to JTC1/SC21 on Changes to ASN.1, SC18/WG3 (title is in error--changes are for ODA, ISO 8613), 22 February 1990
CCITT T.400	Introduction to Document Architecture, Transfer and Manipulation
CCITT T.411	Open Document Architecture (ODA) and Interchange Format - Introduction and General Principles (see DIS 8613-1)
CCITT T.412	Open Document Architecture (ODA) and Interchange Format - Document Structures (see DIS 8613-2)
CCITT T.414	Open Document Architecture (ODA) and Interchange Format - Document Profile (see DIS 8613-4)
CCITT T.415	Open Document Architecture (ODA) and Interchange Format - Open Document Interchange Format (ODIF) (see DIS 8613-5)
CCITT T.416	Open Document Architecture (ODA) and Interchange Format - Character Content Architectures (see DIS 8613-6)
CCITT T.417	Open Document Architecture (ODA) and Interchange Format - Raster Graphics Content Architectures (see DIS 8613-7)
CCITT T.418	Open Document Architecture (ODA) and Interchange Format - Geometric Graphics Content Architectures (see DIS 8613-8)
CCITT T.431	Document Transfer and Manipulation (DTAM) - Services and Protocols, Introduction and General Principles
CCITT T.432	DTAM - Services and Protocols, Service Definition
CCITT T.433	DTAM - Services and Protocols, Protocol Specification
CCITT T.441	DTAM - Operational Structure

CCITT T.501	Document Application Profile MM for the Interchange of Formatted Mixed Mode Documents (Mixed Mode)
CCITT T.502	Document Application Profile PM1 for the Interchange of Processible Form Documents (Teletex Processible Mode)
CCITT T.503	Document Application Profile for the Interchange of Group 4 Facsimile Documents

Y. PICTURE DESCRIPTION INFORMATION EXCHANGE:

ISO 8632-1	Computer Graphics Metafile (CGM): Metafile for the Storage and Transfer of Picture Description Information - Part 1: Functional Specification
	DAD 1 Audit Trail Metafile
	PDAD 2 3D Static Picture Capture Metafile
ISO 8632-2	CGM: Metafile for the Storage and Transfer of Picture Description Information - Part 2: Character Encoding
ISO 8632-3	CGM: Metafile for the Storage and Transfer of Picture Description Information - Part 3: Binary Encoding
ISO 8632-4	CGM: Metafile for the Storage and Transfer of Picture Description Information - Part 4: Clear Text Encoding
DIS 9281	Identification of Picture Coding Methods
SC21 N 4192	Proposed FTAM Document Type to Support CGM, SC21/WG5, December 1989
SC21 N 5165	FTAM Constraint Set and Document Types for CGM, SC21/WG5, June 1990

Z. STANDARD GENERALIZED MARKUP LANGUAGE (SGML):

ISO 8879	Standard Generalized Markup Language (SGML)
ISO 9069	SGML Support Facilities - SGML Document Interchange Format (SDIF)
DIS 9070	SGML Support Facilities - Registration Procedures for Public Text Owner Identifiers
TR 9573	SGML Support Facilities - Techniques Using SGML
DTR 10037	SGML and Text-Entry Systems - Guidelines for SGML Syntax-Directed Editing Systems

AA. OTHER APPLICATION LAYER STANDARDS:

CCITT X.3♦	Packet Assembly/Disassembly Facility (PAD) in a Public Data Network (PDN)
CCITT X.28♦	DTE/DCE Interface for a Start/Stop Mode DTE Accessing the PAD in a PDN Situated in the Same Directory
CCITT X.29♦	Procedures for the Exchange of Control Information and User Data Between a PAD and a Packet Mode or Another PAD

IX. MISCELLANEOUS STANDARDS[32]

A. INTEGRATED SERVICES DIGITAL NETWORK (ISDN): GENERAL STANDARDS[33]

ISO 9574♦	Provision of the OSI Connection-Mode Network Service by Packet Mode Terminal Equipment Connected to an ISDN
CCITT I.110	General Structure of the I-Series Recommendations
CCITT I.111	Relationship With Other Recommendations Relevant to ISDNs
CCITT I.120	ISDNs
CCITT I.130	Attributes for the Characterization of Telecommunications Service Supported by an ISDN and Network Capabilities of an ISDN
CCITT I.210	Principles of Telecommunications Services Supported by an ISDN
CCITT I.211	Bearer Services Supported by an ISDN
CCITT I.212	Teleservices Supported by an ISDN
CCITT I.310	ISDN - Network Functional Principles
CCITT I.320	ISDN Protocol Reference Model
CCITT I.330	ISDN Numbering and Addressing Principles
CCITT I.331	Numbering Plan for the ISDN Era
CCITT I.410	General Aspects and Principles Relating to Recommendations on ISDN User-Network Interfaces

B. ELECTRONIC DATA INTERCHANGE (EDI):

ISO 9735	Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) - Application Level Syntax Rules
SC21 N 5189	Liaison Statement to JTC1/SWG-EDI on EDIFACT Document Types for FTAM, SC21/WG5, June 1990
SC21 N 3925	Liaison Statement to JTC1 SC21 from JTC1 SWG-EDI, JTC1 SWG-EDI, 19 October 1989
SC21 N 4799	Letter for Information on Disposition of EDIMS Use of Directory, 21 May 1990

C. TELEMATIC SERVICES:

DP 9071-1.2	Text and Office Systems - Basic and Optional Requirements - Part 1: Facsimile Equipment
DP 9071-2.2	Text and Office Systems - Basic and Optional Requirements - Part 2: Text Communications Terminals
CCITT T.0	Classification of Facsimile Apparatus for Document Transmission Over the Public Networks

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32 The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

33 A complete list of CCITT 1988 Recommendations on ISDN is provided in Appendix E, Section II.B.

D. VOCABULARY AND REPRESENTATIONS:

ISO 2382-9	Vocabulary - Part 9: Data Communications
ISO 2382-17	Data Processing - Vocabulary - Part 17: Databases, September 1989 [SC21 N 3808]
ISO 2382-26	Data Processing - Vocabulary - Part 26: OSI Architecture, September 1989 [SC21 N 3802]
ISO 3307	Representations of Time of the Day
ISO 3534	Statistics - Vocabulary and Symbols, 1977
ISO 4031	Representation of Local Time Differentials
ISO 6093	Representation of Numeric Values in Character Strings for Information Exchange
ISO 6523	Data Interchange - Structure for the Identification of Organizations
DP 7826	Representation of Data Elements
ISO 8211	Specification for a Data Descriptive File for Information Interchange
DIS 8601	Representation of Dates and Times
ISO 8790	Computer System Configuration Diagram Symbols and Conventions
DIS 9282-1	Coded Representation of Pictures - Part 1: Encoding Principles for Picture Representation in a 7- or 8-Bit Environment
DIS 9282-2	Coded Representation of Pictures - Part 2: Encoding Principles for Photographic Images
DTR 9544	Computer-Assisted Publishing - Vocabulary

E. CODED CHARACTER SETS:

ISO 646	ISO 7-Bit Coded Character Set for Information Exchange
ISO 2022	ISO 7-Bit and 8-Bit Coded Character Sets - Code Extension Techniques
ISO 4873	8-Bit Code for Information Interchange - Structure and Rules for Implementation
DIS 6429	ISO 7-Bit and 8-Bit Coded Character Sets - Control Functions for Coded Character Sets
ISO 6936	Conversion Between the Two Coded Character Sets of ISO 646 and ISO 6937-2 and the CCITT International Telegraph Alphabet No. 2 (ITA2)
DIS 6936	Conversion Between the Two Coded Character Sets of ISO 646 and ISO 6937-2 and the CCITT International Telegraph Alphabet No. 2 (ITA2), Draft Second Edition
ISO 6937-1	Coded Character Sets for Text Communication - Part 1: General Introduction
ISO 6937-2	Coded Character Sets for Text Communication - Part 2: Latin Alphabetic and Non-Alphabetic Graphic Characters DAD 1 Addendum 1
DIS 6937-3	Coded Character Sets for Text Communication - Part 3: Control Functions for Page-Image Format
DIS 6937-7	Coded Character Sets for Text Communication - Part 7: Greek Graphic Characters
DIS 6937-8	Coded Character Sets for Text Communication - Part 8: Cyrillic Graphic Characters
ISO 7350	Registration of Graphic Character Subrepertoires
ISO 8859-1	8-Bit Single-Byte Coded Graphic Character Sets - Part 1: Latin Alphabet No. 1

ISO 8859-2	8-Bit Single-Byte Coded Graphic Character Sets - Part 2: Latin Alphabet No. 2
ISO 8859-3	8-Bit Single-Byte Coded Graphic Character Sets - Part 3: Latin Alphabet No. 3
ISO 8859-4	8-Bit Single-Byte Coded Graphic Character Sets - Part 4: Latin Alphabet No. 4
DIS 8859-5.2	8-Bit Single-Byte Coded Graphic Character Sets - Part 5: Latin/Cyrillic Alphabet
ISO 8859-6	8-Bit Single-Byte Coded Graphic Character Sets - Part 6: Latin/Arabic Alphabet
ISO 8859-7	8-Bit Single-Byte Coded Graphic Character Sets - Part 7: Latin/Greek Alphabet
DIS 8859-8	8-Bit Single-Byte Coded Graphic Character Sets - Part 8: Latin/Hebrew Alphabet
DIS 8859-9	8-Bit Single-Byte Coded Graphic Character Sets - Part 9: Latin Alphabet No. 5
DIS 9541-1	Font and Character Information Exchange - Part 1: Introduction
DIS 9541-2	Font and Character Information Exchange - Part 2: Registration and Naming Procedures
DIS 9541-3	Font and Character Information Exchange - Part 3: Character Identification Method
DIS 9541-4	Font and Character Information Exchange - Part 4: Character Collections
DIS 9541-5	Font and Character Information Exchange - Part 5: Font Attributes and Character Model
DIS 9541-6	Font and Character Information Exchange - Part 6: Font and Character Attribute Subsets and Application
DP 9541-7	Font and Character Information Exchange - Part 7: Font Interchange Format
DP 10646	Multiple Octet Coded Character Set, SC27, November 1989

F. MAN-MACHINE LANGUAGE (MML):

CCITT Z.301	Introduction to the CCITT Man-Machine Language (MML)
CCITT Z.302	The Meta-Language for Describing MML Syntax and Dialogue Procedures
CCITT Z.311	Introduction to Syntax and Dialogue Procedures (MML)
CCITT Z.312	Basic Format Layout (MML)
CCITT Z.314	The Character Set and Basic Elements (MML)
CCITT Z.315	Input (Command) Language Syntax Specification (MML)
CCITT Z.316	Output Language Syntax Specification (MML)
CCITT Z.317	Man-Machine Dialogue Procedures (MML)
CCITT Z.321	Introduction to the Extended MML for Visual Display Terminals
CCITT Z.322	Capabilities of Visual Display Terminals
CCITT Z.323	Man-Machine Interaction
CCITT Z.331	Introduction to the Specification of the Man-Machine Interface
CCITT Z.332	Methodology for the Specification of the Man-Machine Interface - General Working Procedures
CCITT Z.333	Methodology for the Specification of the Man-Machine Interface - Tools and Methods
CCITT Z.341	Glossary of Terms (MML)

G. SOFTWARE DEVELOPMENT AND DOCUMENTATION:

ISO 1538	Programming Languages - ALGOL 60, 1984
ISO 1539	Programming Languages - FORTRAN
ISO 1989	Programming Languages - COBOL
ISO 6160	Programming Languages - PL/1
ISO 6373	Programming Languages - BASIC
ISO 6522	Programming Languages - PL/1 General Purpose Subset
ISO 6592	Guidelines for the Documentation of Computer-Based Application Systems
ISO 7185	Programming Languages - Pascal
DP 8485	Programming Languages - APL
ISO 8652	Programming Languages - Ada
DTR 9294	Guidelines for the Management of Software Documentation, Technical Report Type 3
ISO 9496.2	Programming Languages - CCITT High Level Language (CHILL)
TR 9547	Programming Language Processors - Test Methods - Guidelines for Their Development and Acceptability, April 1988
CCITT Z.200	CCITT High Level Language (CHILL) [see ISO 9496.2]
DTR 10034	Guidelines for the Preparation of Conformity Clauses in Programming Language Standards

H. INFORMATION PROCESSING EQUIPMENT:

DIS 8884	Keyboards for Multiple Latin-Alphabet Languages - Layout and Operation Using Four Levels
ISO 9660	Volume and File Structure of CD-ROM for Information Exchange
DIS 9995-30	Keyboard Layouts for Text and Office Systems - Part 30: Numeric Section, October 1988
DIS 9995-31	Keyboard Layouts for Text and Office Systems - Part 31: Numeric Zone of the Numeric Section, October 1988
DIS 9995-41	Keyboard Layouts for Text and Office Systems - Part 30: Function Zones of the Numeric Section, October 1988
DP 10033	Recording of Documents Conforming to ISO 8613 on Flexible Disk Cartridges Conforming to ISO 9293
DIS 10149	Data Interchange on Read-Only 120-mm Optical Data Disks (CD-ROM)

APPENDIX E

NUMERICAL LISTING OF ISO STANDARDS RELEVANT TO ATCCIS

NUMERICAL LISTING OF ISO STANDARDS AND CCITT RECOMMENDATIONS RELEVANT TO CCISs[1]

I. ISO STANDARDS

ISO 646	Information Processing - ISO 7-Bit Coded Character Set for Information Exchange, July 1983
ISO 1155	Use of Longitudinal Parity to Detect Errors in Information Messages
ISO 1177	Character Structure for Start/Stop and Synchronous Character Oriented Transmission
ISO 1538	Programming Languages - ALGOL 60, 1984
ISO 1539	Programming Languages - FORTRAN, 1980
ISO 1745	Information Processing - Basic Mode Control Procedures for Data Communication Systems, February 1975
ISO 1989	Programming Languages - COBOL, 1978
ISO 2022	Information Processing - ISO 7-Bit and 8-Bit Coded Character Sets - Code Extension Techniques, Third Edition, May 1986
ISO 2110.3♦[2]	Data Communication - 25-Pin DTE/DCE Interface Connector and Pin Assignments, Third Edition, 10 April 1989
ISO 2110 AD1	Data Communication - 25-Pin DTE/DCE Interface Connector and Pin Assignments, Addendum 1, Interface Connector and Contact Number Assignments for a DTE/DCE for Data Signalling Rates Above 20 kbit/s, June 1989
ISO 2111	Data Communication - Basic Mode Control Procedures - Code Independent Information Transfer, Second Edition, February 1985
ISO 2375	Data Processing - Procedures for the Registration of Escape Sequences, November 1985
ISO 2382-9	Data Processing - Vocabulary - Part 9: Data Communications, March 1984
ISO 2382-17	Data Processing - Vocabulary - Part 17: Databases, September 1989 [SC21 N 3808]
ISO 2382-26	Data Processing - Vocabulary - Part 26: OSI Architecture, September 1989 [SC21 N 3802]
ISO 2593♦	Data Communication - 34-Pin DTE/DCE Interface Connector and Pin Assignments, Second Edition, 1989
ISO 2628	Basic Mode Control Procedures - Complements, June 1973
ISO 2629	Basic Mode Control Procedures - Conversational Information Message Transfer, February 1973

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1 Based on data initially provided by OMNICON in September 1988. Revised July 1990 based on *The OMNICON Index of Standards for Distributed Information and Telecommunications*, 1989, OMNICON, Inc., and status of standards papers from ISO/IEC JTC1, ANSI X3, and the British Standards Institution (BSI). The BSI document, *ISO/IEC JTC1/SC21 Project File*, IST/21:2089, 12 April 1990, was a major source for updating the list of standards.

2 The symbol ♦ is used throughout this Appendix to identify those standards included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

ISO 3307	Information Interchange - Representations of Time of the Day, March, 1975
ISO 3309♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Frame Structure, Third Edition, October 1984
ISO 3309 DAD 1♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Frame Structure - Addendum 1: Start/Stop transmission, 1989
ISO 3309 WDAD 2♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Frame Structure - Addendum 2: Extended Transparency Option, 1989
ISO 3534	Statistics - Vocabulary and Symbols, 1977
ISO 4031	Information Interchange - Representation of Local Time Differentials, December 1987
ISO 4335♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures, Elements of Procedures, Third Edition, August 1987
ISO 4335 AD 1♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures, Elements of Procedures - Addendum 1: Asynchronous (Start/Stop) Transmission Operation, 1989
ISO 4335 AD 2♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures, Elements of Procedures - Addendum 2: Enhancement of the XID Function Utility, 1989
ISO 4335 DAD 3♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Element of Procedures - Addendum 3: Start/Stop Transmission, 1989
ISO 4335 PDAD 4♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Element of Procedures - Addendum 4: Flow Control Unnumbered Information (FUI), 1989
ISO 4335 PDAD 5♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Element of Procedures - Addendum 5: Multi-Selective Reject, 1989
ISO 4873	Information Processing - 8-Bit Code for Information Interchange - Structure and Rules for Implementation, July 1986
ISO 4902.3♦	Data Communication - 37-Pin and 9-Pin DTE/DCE Interface Connectors and Pin Assignments, Third Edition, 1989
ISO 4903.3♦	Data Communication - 15-Pin DTE/DCE Interface Connector and Pin Assignments, Third Edition, 1989
ISO 6093	Information Processing - Representation of Numeric Values in Character Strings for Information Exchange, November 1985
ISO 6160	Programming Languages - PL/1, 1979
ISO 6373	Programming Languages - BASIC
DIS 6429	ISO 7-Bit and 8-Bit Coded Character Sets - Control Functions for Coded Character Sets, May 1987
ISO 6522	Programming Languages - PL/1 General Purpose Subset, 1985
ISO 6523	Data Interchange - Structure for the Identification of Organizations, February 1984
ISO 6592	Information Processing - Guidelines for the Documentation of Computer-Based Application Systems, November 1985

ISO 6936	Information Processing - Conversion Between the Two Coded Character Sets of ISO 646 and ISO 6937-2 and the CCITT International Telegraph Alphabet No. 2 (ITA2), May 1983
DIS 6936	Information Processing - Conversion Between the Two Coded Character Sets of ISO 646 and ISO 6937-2 and the CCITT International Telegraph Alphabet No. 2 (ITA2), Draft Second Edition, October 1987
ISO 6937-1	Information Processing - Coded Character Sets for Text Communication - Part 1: General Introduction, November 1983
ISO 6937-2	Information Processing - Coded Character Sets for Text Communication - Part 2: Latin Alphabetic and Non-Alphabetic Graphic Characters, December 1983
ISO 6937-3 DAD1	Information Processing - Coded Character Sets for Text Communication - Part 2: Latin Alphabetic and Non-Alphabetic Graphic Characters, Addendum 1, September 1987
DIS 6937-3	Information Processing - Coded Character Sets for Text Communication - Part 3: Control Functions for Page-Image Format, March 1988
DIS 6937-7	Information Processing - Coded Character Sets for Text Communication - Part 7: Greek Graphic Characters, April 1987
DIS 6937-8	Information Processing - Coded Character Sets for Text Communication - Part 8: Cyrillic Graphic Characters, April 1987
ISO 7185	Programming Languages - Pascal, 1983
ISO 7350	Text Communication - Registration of Graphic Character Subrepertoires, March 1984
DIS 7350	Text Communication - Registration of Graphic Character Subrepertoires, Draft Second Edition, October 1987
TR 7477♦	Data Communication - Arrangement for DTE to DTE Physical Connection Using V.24 and X.24 Interchange Circuits, September 1985
ISO 7478♦	Information Processing Systems - Data Communication - Multilink Procedures, July 1987
ISO 7478/Cor 1	Information Processing Systems - Data Communication - Multilink Procedures, Technical Corrigendum 1, 1 March 1989 [SC21 N 2738, June 1988]
ISO 7480♦	Information Processing - Start-Stop Transmission Signal Quality at DTE/DCE Interfaces, October 1984
ISO 7498-1♦	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 1: General Aspects, December 1988 [SC21/WG1, SC21 N 3273] (CD text for revision incorporating AD1 expected November 1990)
ISO 7498-1/Cor 1	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 1: General Aspects, Technical Corrigendum 1, 15 December 1988
ISO 7498-1 AD 1♦	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 1: General Aspects, Addendum 1: Connectionless-Mode Transmission, July 1987
ISO 7498-1 DAD 2♦	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 1: General Aspects, Addendum 2: Multipeer Data Transmission (MPDT) [SC21 N 3287] (Reassessment Report, SC21 N 3906, September 1989; project suspended in November 1989, SC21 N 4276)
ISO 7498-1 PDAD 3♦	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 1: General Aspects, Addendum 3: Upper Layer Architecture (ULA)

ISO 7498-2♦	Information Processing Systems - Open Systems Interconnection Reference Model - Part 2: Security Architecture, February 1989
DIS 7498-3♦	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 3: Naming and Addressing, March 1989
DIS 7498-4♦	Information Processing Systems - Open Systems Interconnection - Basic Reference Model - Part 4: Management Framework, November 1989 [SC21 N 3502, 24 April 1989]
ISO 7776♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Description of the X.25 LAPB-Compatible DTE Data Link Procedures, December 1986
ISO 7776/Cor 1	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Description of the X.25 LAPB-Compatible DTE Data Link Procedures, Technical Corrigendum 1, 1 April 1989
ISO 7776 PDAD 1	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Description of the X.25 LAPB-Compatible DTE Data Link Procedures, Addendum 1: PICS Proforma, 1989
ISO 7809♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Consolidation of Classes of Procedures, February 1984
ISO 7809 AD 1♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Consolidation of Classes of Procedures - Addendum 1 (no title; contains UI Command/Responses), June 1986
ISO 7809 AD 2♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Consolidation of Classes of Procedures, Addendum 2: Descriptions of Optional Functions, June 1987
ISO 7809 DAD 3♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Classes of Procedures - Addendum 3: Start/Stop Transmission, 1989
ISO 7809 PDAD 4♦	Information Processing Systems - Data Communication - High Level Data Link Control (HDLC) Procedures - Consolidation of Classes of Procedures - Addendum 4: List of Standard Data Link Layer Protocols That Utilize HDLC Classes of Procedures, March 1988 (DP) [see DTR 10171, March 1989]
ISO 7809 PDAD 5♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Classes of Procedures - Addendum 5: Connectionless Class of Procedure, 1989
ISO 7809 PDAD 6♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Classes of Procedures - Addendum 6: Extended Transparency Option, 1989
ISO 7809 PDAD 7♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - Classes of Procedures - Addendum 7: Multi-Selective Reject, 1989
DP 7826	Representation of Data Elements
ISO 7942	Information Processing Systems - Computer Graphics - Graphical Kernel System (GKS) Functional Description, August 1985
ISO 7942 DAD1	Information Processing Systems - Computer Graphics - Graphical Kernel System (GKS) Functional Description, Addendum 1: Audit Trail Metafile, 1989
ISO 8072♦	Information Processing Systems - Open Systems Interconnection - Transport Service Definition, 15 June 1986

ISO 8072 AD 1♦	Information Processing Systems - Open Systems Interconnection - Transport Service Definition - Addendum 1: Connectionless-Mode Transmission, 15 July 1986
ISO 8073♦	Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Protocol Specification, 15 July 1986
ISO 8073 AD 1♦	Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Protocol Specification - Addendum 1: Network Connection Management Subprotocol, June 1988
ISO 8073 DAD 2♦	Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Protocol Specification - Addendum 2: Class Four Operation Over Connectionless Network Service, July 1987
ISO 8073 DAD 3♦	Information Processing System - Open Systems Interconnection - Connection Oriented Transport Protocol Specification - Addendum 3: Protocol Implementation Conformance Statement Proforma, 1989
ISO 8208♦	Information Processing Systems - Data Communications - X.25 Packet Level Protocol (PLP) for Data Terminal Equipment, September 1987
ISO 8208 DAD 1.2♦	Information Processing Systems - X.25 Packet Level Protocol (PLP) for Data Terminal Equipment - Addendum 1: Alternative Logical Channel Number Allocation, 1989
ISO 8208 PDAD 2♦	Information Processing Systems - X.25 Packet Level Protocol (PLP) for Data Terminal Equipment - Addendum 2 - Extensions for Private and Switched Use (project cancelled; addendum WITHDRAWN, 1989)
ISO 8208 DAD 3♦	Information Processing Systems - Data Communications - X.25 Packet Level Protocol (PLP) for Data Terminal Equipment - Addendum 3: Packet Level Static Conformance Requirements, 1989
ISO 8211	Information Processing - Specification for a Data Descriptive File for Information Interchange, December 1985
ISO 8326♦	Information Processing Systems - Open Systems Interconnection - Connection Oriented Session Service Definition, 15 August 1987; revised to incorporate AD1, AD2, and AD3 (draft 19 April 1990, SC21 N 4657); Technical Corrigendum, 30 April 1990 [SC21 N 4637 and 4638]
ISO 8326 AD 1♦	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Service Definition - Addendum 1: Session Symmetric Synchronization for the Session Service [SC21 N 3507, October 1989]; incorporated into ISO 8326, April 1990
ISO 8326 AD 2♦	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Service Definition - Addendum 2: Incorporation of Unlimited User Data, [SC21 N 2495, 27 June 1988]; incorporated into ISO 8326, April 1990
ISO 8326 AD 3♦	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Service Definition - Addendum 3: Connectionless-Mode Session Service [SC21 N 3462, August 1989]; incorporated into ISO 8326, April 1990
ISO 8326 WDAM 4	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Service Definition - Addendum 4: Additional Resynchronization Functionality, July 1990 [SC21 N 5040] (CD text expected October 1990)
ISO 8327♦	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification, 15 August 1987; revised to incorporate AD1 and AD2 (draft 19 April 1990, SC21 N 4656); Technical Corrigendum, 30 April 1990 [SC21 N 4663-4666]

ISO 8327 AD 1♦	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification - Addendum 1: Session Symmetric Synchronization for the Session Protocol [SC21 N 3508, October 1989]; incorporated into ISO 8327, April 1990
ISO 8327 AD 2♦	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification - Addendum 2: Incorporation of Unlimited User Data [SC21 N 2494, 27 June 1988]; incorporated into ISO 8327, April 1990
ISO 8327 WDAM 4	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification - Addendum 4: Additional Resynchronization Functionality, July 1990 [SC21 N 5041] (CD text expected October 1990)
CD 8327-2♦	Information Processing Systems - Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification - Part 2: Protocol Implementation Conformance Statement (PICS) Proforma, July 1990 [SC21 N 5022] (DIS text expected November 1990, IS text November 1991)
ISO 8348♦	Information Processing Systems - Data Communications - Network Service Definition, 15 April 1987
ISO 8348 AD 1♦	Information Processing Systems - Data Communications - Network Service Definition - Addendum 1: Connectionless-Mode Transmission, 15 April 1987
ISO 8348 AD 2♦	Information Processing Systems - Data Communications - Network Service Definition - Addendum 2: Network Layer Addressing, 1 June 1988
ISO 8348 AD 3♦	Information Processing Systems - Data Communications - Network Service Definition - Addendum 3: Additional Features of the Network Service, 15 October 1988
ISO 8372	Information Processing - Modes of Operation for a 64-bit Block Cipher Algorithm, 1987
ISO 8471♦	Data Communication - High-Level Data Link Control (HDLC) Balanced Classes of Procedures - Data-Link Layer Address Resolution/ Negotiation in Switched Environments, April 1987
ISO 8473♦	Information Processing Systems - Data Communications - Protocol for Providing the Connectionless-Mode Network Service (CLNS), January 1988
ISO 8473 PDAD 1♦	Information Processing Systems - Data Communications - Protocol for Providing the Connectionless-Mode Network Service (CLNS) - Addendum 1: Provision of Underlying Service Assumed by ISO 8473 Over Point-to-Point Subnetworks Which Provide the OSI Data Link Service, July 1987 (DP)
ISO 8473 PDAD 2♦	Information Processing Systems - Data Communications - Protocol for Providing the Connectionless-Mode Network Service (CLNS) - Addendum 2: Estelle Formal Description of ISO 8473, Revised Edition, April 1988 (to be reballoted as a DTR)
ISO 8473 AD 3♦	Information Processing Systems - Data Communications - Protocol for Providing the Connectionless-Mode Network Service (CLNS) - Addendum 3: Provision of the Underlying Service Assumed by ISO 8473 over Subnetworks Which Provide the OSI Data Link Service, 15 February 1989
ISO 8480♦	Information Processing - Data Communication - DTE/DCE Interface Back-up Control Operation Using the 25-Pole Connector, November 1987
ISO 8481♦	Data Communication - DTE to DTE Physical Connection Using X.24 Interchange Circuits with DTE Providing Timing, September 1986

ISO 8482♦	Information Processing Systems - Data Communication - Twisted Pair Multipoint Interconnections, November 1987
DP 8485	Programming Languages - APL
DIS 8505	Information Processing Systems - Text Communication - Functional Description and Service Specification for Message Oriented Text Interchange Systems (MOTIS), February 1986 (WITHDRAWN, superceded by ISO 10021)
TR 8509♦	Information Processing Systems - Open Systems Interconnection - Service Conventions, September 1987
ISO 8571-1♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 1: General Introduction, Revised Edition, October 1988; Technical Corrigendum 1, February 1990 [SC21 N 4371]
ISO 8571-1 DAM1♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 1: General Introduction, Amendment 1: Filestore Management, July 1990 [SC21 N 3917, October 1989] (editing meeting scheduled March 1991)
ISO 8571-1 PDAM2♦	Information Processing Systems - Open Systems Interconnection - File Transfer. Access and Management (FTAM) - Part 1: General Introduction, Amendment 2: Overlapped Access, 13 April 1990 [SC21 N 4177, October 1989] (editing meeting scheduled November 1990)
ISO 8571-1/5	Amendments to Parts 1-5: Enhancement to FTAM Services to Satisfy Additional User Requirements, PCDAMs, SC21/WG5, July 1990 [SC21 N 5155] (new work item; CD text expected May 1991, DIS text in February 1992, IS text in February 1993)
ISO 8571-2♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 2: Virtual Filestore Definition, Revised Edition, October 1988; Technical Corrigendum 1, February 1990 [SC21 N 4372]
ISO 8571-2 DAM1♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 2: Virtual Filestore Definition, Amendment 1: Filestore Management, July 1990 [SC21 N 3918, October 1989] (editing meeting scheduled March 1991)
ISO 8571-2 PDAM2♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 2: Virtual Filestore Definition, Amendment 2: Overlapped Access, 13 April 1990 [SC21 N 4178, October 1989] (editing meeting scheduled November 1990)
ISO 8571-3♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 3: File Service Definition, Revised Edition, October 1988; Technical Corrigendum 1, February 1990 [SC21 N 4373]
ISO 8571-3 DAM1♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 2: File Service Definition, Amendment 1: Filestore Management, July 1990 [SC21 N 3919, October 1989] (editing meeting scheduled March 1991)
ISO 8571-3 PDAM2♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 2: File Service Definition, Amendment 2: Overlapped Access, 13 April 1990 [SC21 N 4179, October 1989] (editing meeting scheduled November 1990)
ISO 8571-4♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 4: File Protocol Specification, Revised Edition, October 1988; Technical Corrigendum 1, February 1990 [SC21 N 4374]

ISO 8571-4 DAM1♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 4: File Protocol Specification, Amendment 1: Filestore Management, July 1990 [SC21 N 3920, October 1989] (editing meeting scheduled March 1991)
ISO 8571-4 PDAM2♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 4: File Protocol Specification, Amendment 2: Overlapped Access, 13 April 1990 [SC21 N 4180, October 1989] (editing meeting scheduled November 1990)
ISO 8571-5♦	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 5: Protocol Implementation Conformance Statement Proforma, July 1990 [SC21 N 3467, April 1989]
ISO 8571-5 WDAM1	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 5: Protocol Implementation Conformance Statement Proforma, Amendment 1: Filestore Management, July 1990 (new subproject; formal WD expected November 1990; CD text in January 1991)
ISO 8571-5 WDAM2	Information Processing Systems - Open Systems Interconnection - File Transfer, Access and Management (FTAM) - Part 5: Protocol Implementation Conformance Statement Proforma, Amendment 2: Overlapped Access, July 1990 (new subproject; CD text expected November 1991)
DIS 8601	Data Elements and Interchange Formats - Information Exchange - Representation of Dates and Times, June 1986
ISO 8602♦	Information Processing Systems - Open Systems Interconnection - Protocol for Providing the Connectionless-Mode Transport Service, 15 December 1987
ISO 8613-1♦	Information Processing - Text and Office Systems - Office Document Architecture (ODA) and Interchange Format - Part 1: Introduction and General Principles, July 1988 [CCITT T.411]
ISO 8613-2♦	Information Processing - Text and Office Systems - Office Document Architecture (ODA) and Interchange Format - Part 2: Document Structures, July 1988 [CCITT T.412]
ISO 8613-2 PDAD 1	Information Processing - Text and Office Systems - Office Document Architecture (ODA) and Interchange Format - Part 2: Document Structures - Addendum 1: Formal Specification of ODA Document Structures, June 1988
ISO 8613-3♦	Information Processing - Text and Office Systems - Office Document Architecture (ODA) and Interchange Format - Part 3: Document Processing Reference Model, September 1986 (WITHDRAWN)
ISO 8613-4♦	Information Processing - Text and Office Systems - Office Document Architecture (ODA) and Interchange Format - Part 4: Document Profile, July 1988 [CCITT T.414]
ISO 8613-5♦	Information Processing - Text and Office Systems - Office Document Architecture (ODA) and Interchange Format - Part 5: Office Document Interchange Format (ODIF), July 1988 [CCITT T.415]
ISO 8613-6♦	Information Processing - Text and Office Systems - Office Document Architecture (ODA) and Interchange Format - Part 6: Character Content Architectures, July 1988 [CCITT T.416]
ISO 8613-7♦	Information Processing - Text and Office Systems - Office Document Architecture (ODA) and Interchange Format - Part 7: Raster Graphics Content Architectures, July 1988 [CCITT T.417]

ISO 8613-8♦	Information Processing - Text and Office Systems - Office Document Architecture (ODA) and Interchange Format - Part 8: Geometric Graphics Content Architectures, July 1988 [CCITT T.418]
ISO 8632-1	Information Processing Systems - Computer Graphics - Metafile (CGM) for the Storage and Transfer of Picture Description Information - Part 1: Functional Specification, 1 August 1987
ISO 8632-1 DAD1	Information Processing Systems - Computer Graphics - Metafile (CGM) for the Storage and Transfer of Picture Description Information - Part 1: Functional Specification, Addendum 1: Audit Trail Metafile, 1989
ISO 8632-1 PDAD2	Information Processing Systems - Computer Graphics - Metafile (CGM) for the Storage and Transfer of Picture Description Information - Part 1: Functional Specification, Addendum 2: 3D Static Picture Capture Metafile, 1989
ISO 8632-2	Information Processing Systems - Computer Graphics - Metafile (CGM) for the Storage and Transfer of Picture Description Information - Part 2: Character Encoding, 1 August 1987
ISO 8632-3	Information Processing Systems - Computer Graphics - Metafile (CGM) for the Storage and Transfer of Picture Description Information - Part 3: Binary Encoding, 1 August 1987
ISO 8632-4	Information Processing Systems - Computer Graphics - Metafile (CGM) for the Storage and Transfer of Picture Description Information - Part 4: Clear Text Encoding, 1 August 1987
ISO 8648♦	Information Processing Systems - Open Systems Interconnection - Internal Organization of the Network Layer, 15 February 1988
ISO 8649♦	Information Processing Systems - Open Systems Interconnection - Service Definition for the Association Control Service Element (ACSE), 15 December 1988 [SC21 N 2326, January 1988] (defect report ballots SC21 N 4447-49, February 1990)
ISO 8649 DAD 1♦	Information Processing Systems - Open Systems Interconnection - Service Definition for the Association Control Service Element (ACSE) - Addendum 1: Peer-Entity Authentication During Association Establishment, September 1989 [SC21 N 3771] (editing meeting July 1990)
ISO 8649 AD 2♦	Information Processing Systems - Open Systems Interconnection - Service Definition for the Association Control Service Element (ACSE) - Connectionless-Mode ACSE Service, 1 June 1990 [SC21 N 4937]
ISO 8649 WDAD 3♦	Information Processing Systems - Open Systems Interconnection - Service Definition for the Association Control Service Element (ACSE) - Application Context Management, 1989 (CD text expected October 1991)
ISO 8650♦	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Association Control Service Element (ACSE), 15 December 1988; Technical Corrigendum, 1 June 1990; Amendment, February 1990, SC21 N 4286]
ISO 8650 DAD 1♦	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Association Control Service Element (ACSE) - Addendum 1: Peer-Entity Authentication During Association Establishment, September 1989 [SC21 N 3772] (editing meeting July 1990)
ISO 8650 WDAD 3♦	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Association Control Service Element (ACSE) - Addendum 3: Application Context Management, 1989 (CD text expected October 1991)

ISO 8650 WDAD 4♦	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Association Control Service Element (ACSE) - Addendum 4: Application Entity Titles, 1989
DIS 8650-2♦	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Association Control Service Element (ACSE) - Part 2: PICS Proforma, July 1990 [SC21 N 5024] (IS text expected June 1991)
ISO 8651-1	Information Processing Systems - Computer Graphics - Graphical Kernel System (GKS) Language Bindings - Part 1: FORTRAN, October 1988
ISO 8651-2	Information Processing Systems - Computer Graphics - Graphical Kernel System (GKS) Language Bindings - Part 2: Pascal, October 1988
ISO 8651-3	Information Processing Systems - Computer Graphics - Graphical Kernel System (GKS) Language Bindings - Part 3: Ada, October 1988
WD 8651-4	Information Processing Systems - Computer Graphics - Graphical Kernel System (GKS) Language Bindings - Part 4: C, 1989
ISO 8652	Programming Languages - Ada
ISO 8790	Information Processing Systems - Computer System Configuration Diagram Symbols and Conventions, September 1987
DP 8800-1	Information Processing Systems - IRDS - Part 1: Command Language and Panel Interface, April 1987 [SC21 N 1789] (projected suspended until the IRDS services interface reaches DIS status; the command language and panel interface are expected to be split into separate standards)
ISO 8802-1♦	Information Processing Systems - Local Area Networks - Part 1: General Introduction, 1989
ISO 8802-2.2♦	Information Processing Systems - Local Area Networks - Part 2: Logical Link Control, Second Edition, 1989
ISO 8802-2.2 DAD 1♦	Information Processing Systems - Local Area Networks - Part 2: Logical Link Control - Addendum 1: Flow Control Techniques for Bridged Local Area Networks, May 1988
ISO 8802-2.2 DAD 2♦	Information Processing Systems - Local Area Networks - Part 2: Logical Link Control - Addendum 2: Type 3 Operation-Acknowledge Connectionless Service, October 1988
ISO 8802-2.2 PDAD 4	Information Processing Systems - Local Area Networks - Part 2: Logical Link Control - Addendum 4: Editorial Changes and Technical Corrections, June 1989
ISO 8802-3♦	Information Processing Systems - Local Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications, November 1987
ISO 8802-3 DAD 1♦	Information Processing Systems - Local Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) - Addendum 1: Physical Signalling, Medium Attachment, and Baseband Medium Specifications for Type 1BASE5, 1989
ISO 8802-3 DAD 2♦	Information Processing Systems - Local Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) - Addendum 2: Repeater Set and Repeater Unit Specification for Use with 10BASE5 and 10BASE2 Networks, July 1987
ISO 8802-3 DAD 3♦	Information Processing Systems - Local Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) - Addendum 3: Broadband Medium Attachment Unit and Broadband Medium Specifications, Type 10BROAD36, 1989

ISO 8802-3 PDAD 4♦	Information Processing Systems - Local Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) - Addendum 4: Broadband Medium Attachment Unit and Broadband Medium Specifications, Type 1BASE5 (StarLAN)
ISO 8802-3 DAD 5♦	Information Processing Systems - Local Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) - Addendum 4: Medium Attachment Unit and Baseband Medium Specification for a Vendor-Independent Fibre Optic Inter-Repeater Link (FOIRL), 1989
ISO 8802-4.2♦	Information Processing Systems - Local Area Networks - Part 4: Token-Passing Bus Access Method and Physical Layer Specifications, Second Edition, November 1987
ISO 8802-5♦	Information Processing Systems - Local Area Networks - Part 5: Token Ring Access Method and Physical Layer Specification, February 1987
ISO 8802-5 PDAD 1	Information Processing Systems - Local Area Networks - Part 5: Token Ring Access Method and Physical Layer Specification - Addendum 1: 4 and 16 Mbit/s Specification, June 1989
ISO 8802-5 PDAD 2	Information Processing Systems - Local Area Networks - Part 5: Token Ring Access Method and Physical Layer Specification - Addendum 2: MAC Sublayer Enhancement, July 1989
ISO 8802-5 PDAD 3	Information Processing Systems - Local Area Networks - Part 5: Token Ring Access Method and Physical Layer Specification - Addendum 3: Management Entity Specification, July 1989
ISO 8802-5 PDAD 4	Information Processing Systems - Local Area Networks - Part 5: Token Ring Access Method and Physical Layer Specification - Addendum 4: Source Routing MAC Bridge, June 1989
DIS 8802-6♦	Information Processing Systems - Local Area Networks - Part 6: Distributed Queue Dual Bus (DQDB) Media Access Control (MAC), 1989
ISO 8802-7♦	Information Processing Systems - Local Area Networks - Part 7: Slotted Ring Access Method and Physical Layer Specification, 1989
DIS 8802-9♦	Information Processing Systems - Local Area Networks - Part 9: Integrated Voice and Data (IVD) LAN
ISO 8805	Information Processing Systems - Computer Graphics - Graphical Kernel System for Three Dimensions (GKS-3D) Functional Description, October 1988
DIS 8805 WDAD 1	Working Draft for Information Processing Systems - Computer Graphics - Graphical Kernel System for Three Dimensions (GKS-3D) Addendum 1: Name Set Addendum, April 1987 (WD)
DIS 8806-1	Information Processing Systems - Computer Graphics - Graphical Kernel System for Three Dimensions (GKS-3D) Language Bindings - Part 1: FORTRAN, November 1988
DIS 8806-3	Information Processing Systems - Computer Graphics - Graphical Kernel System for Three Dimensions (GKS-3D) Language Bindings - Part 3: Ada, 1989
DIS 8806-4	Information Processing Systems - Computer Graphics - Graphical Kernel System for Three Dimensions (GKS-3D) Language Bindings - Part 4: C, 1989
ISO 8807♦	LOTOS - A Formal Description Technique Based on the Temporal Ordering of Observational Behaviour, 15 February 1989
ISO 8807 PDAD 1	LOTOS - A Formal Description Technique Based on the Temporal Ordering of Observational Behavior, Addendum 1, Graphical Representation of LOTOS (G-LOTOS) (new work item proposal of July 1989 not accepted; status uncertain) [SC21 N 4228, December 1989]

ISO 8822♦	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Service Definition, 15 August 1988 [SC21 N 2335, April 1988; defect report SC21 N 3761, August 1989]
ISO 8822 AD 1♦	Information Processing Systems - Open Systems Interconnection - Addendum 1: Connectionless-Mode Presentation Service, 1 June 1990 [SC21 N 4933]
ISO 8822 WDAM 2♦	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Service Definition, Amendment 2: Support of Session Symmetric Synchronization Service, February 1990 (CD text expected September 1990)
ISO 8822 CDAM 3	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Service Definition, Amendment 3: Unlimited User Data, July 1990 [SC21 N 5065] (DIS text expected June 1991, IS text in June 1992)
ISO 8822 PDAD 4	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Service Definition, Amendment 4: Abstract Syntax Registration, 20 July 1990 [SC21 N 5067] (DIS text expected June 1991, IS text in June 1992)
ISO 8822 WDAM 5	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Service Definition, Amendment 5: Confidentiality and Integrity, July 1990 [SC21 N 3164, July 1989] (new work item; CDAD expected June 1991)
ISO 8822 WDAM 6	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Service Definition, Amendment 6: Additional Resynchronization Functionality, January 1990 [new work item, SC21 N 4121] (CD text expected October 1990)
ISO 8823♦	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Protocol Specification, 15 August 1988 [SC21 N 2336, April 1988] (defect reports SC21 N 3751-3760, August 1989)
ISO 8823 WDAM 2♦	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Protocol Specification, Amendment 2: Support of Session Symmetric Synchronization Service, February 1990 (CD text expected September 1990)
ISO 8823 CDAM 3	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Protocol Specification, Amendment 3: Unlimited User Data, July 1990 [SC21 N 5066] (DIS text expected June 1991, IS text in June 1992)
ISO 8823 PDAD 4	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Protocol Specification, Amendment 4: Transfer Syntax Registration, 20 July 1990 [SC21 N 5068] (DIS text expected June 1991, IS text in June 1992)
ISO 8823 WDAM 5	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Protocol Specification, Amendment 5: Confidentiality and Integrity, July 1990 [SC21 N 3164, July 1989] (CD text expected June 1991)
ISO 8823 WDAM 6	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Protocol Specification, Amendment 6: Additional Resynchronization Functionality, January 1990 [new work item, SC21 N 4121] (CD text expected October 1990)
DIS 8823-2♦	Information Processing Systems - Open Systems Interconnection - Connection Oriented Presentation Protocol Specification - Part 2: Presentation Protocol Implementation Conformance Statement (PICS) Proforma, July 1990 [SC21 N 5025] (IS text expected November 1991)

ISO 8824♦	Information Processing Systems - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1), December 1987; Revised Edition incorporates AM1, April 1990 [SC21 N 4720]
ISO 8824 DAM 1♦	Information Processing Systems - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1) - Amendment 1: ASN.1 Extensions, June 1988 [SC21 N 2341]; incorporated in Revised Edition of ISO 8824, April 1990
ISO 8824 WDAM 2	Information Processing Systems - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1) - Amendment 2: New Features, July 1989 [SC21 N 3165] (CD text expected June 1991)
ISO 8825♦	Information Processing Systems - Open Systems Interconnection - Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1), November 1987; Revised Edition incorporates AM1, April 1990 [SC21 N 4721]
ISO 8825 DAM 1♦	Information Processing Systems - Open Systems Inte.. nnection - Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1) - Amendment 1: ASN.1 Extensions, June 1988 [SC21 N 2342]; incorporated in Revised Edition of ISO 8825, April 1990
ISO 8825 WDAM 2	Information Processing Systems - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1) - Amendment 2: New Features, July 1989 [SC21 N 3165] (CD text expected June 1991)
WD 8825-2	Conformance Test Suite for the Presentation Protocol - Part 2: Test Suite Structure and Test Purposes for ASN.1 Encodings, SC21/WG6, July 1990 [SC21 N 5019] (CD text expected in February 1991, DIS text in November 1991, IS text in November 1992)
ISO 8831♦	Information Processing Systems - Open Systems Interconnection - Job Transfer and Manipulation (JTM) Concepts and Services, June 1989 [SC21 N 2613, January 1989]
ISO 8832♦	Information Processing Systems - Open Systems Interconnection - Specification of the Basic Class Protocol for Job Transfer and Manipulation (JTM), June 1989 [SC21 N 3633, January 1989]; draft Revised Edition of 12 December 1989 incorporates AD1 [SC21 N 4183]
ISO 8832 DAM1♦	Information Processing Systems - Open Systems Interconnection - Specification of the Basic Class Protocol for Job Transfer and Manipulation, Addendum 1: JTM Full Protocol Specification, 28 May 1990 [SC21 N 5225, text with amendment incorporated; and SC21 N 5224, amendment alone] (IS text expected November 1991)
ISO 8859-1	Information Processing - 8-Bit Single-Byte Coded Graphic Character Sets - Part 1: Latin Alphabet No. 1, February 1987
ISO 8859-2	Information Processing - 8-Bit Single-Byte Coded Graphic Character Sets - Part 2: Latin Alphabet No. 2, February 1987
ISO 8859-3	Information Processing - 8-Bit Single-Byte Coded Graphic Character Sets - Part 3: Latin Alphabet No. 3, April 1988
ISO 8859-4	Information Processing - 8-Bit Single-Byte Coded Graphic Character Sets - Part 4: Latin Alphabet No. 4, April 1988
DIS 8859-5.2	Information Processing - 8-Bit Single-Byte Coded Graphic Character Sets - Part 5: Latin/Cyrillic Alphabet, December 1987
ISO 8859-6	Information Processing - 8-Bit Single-Byte Coded Graphic Character Sets - Part 6: Latin/Arabic Alphabet, August 1987
ISO 8859-7	Information Processing - 8-Bit Single-Byte Coded Graphic Character Sets - Part 7: Latin/Greek Alphabet, November 1987

DIS 8859-8	Information Processing - 8-Bit Single-Byte Coded Graphic Character Sets - Part 8: Latin/Hebrew Alphabet, July 1987
DIS 8859-9	Information Processing - 8-Bit Single-Byte Coded Graphic Character Sets - Part 9: Latin Alphabet No. 5, August 1988
ISO 8877♦	Information Processing Systems - Interface Connector and Contact Assignments for ISDN Basic Access Interface Located at Reference Points S and T, August 1987
ISO 8877 DAD 1♦	Information Processing Systems - Interface Connector and Contract Assignments for ISDN Basic Access Located at Reference Points S and T - Addendum 1: Standard ISDN Basic Access TE Connecting Cord, 1989
ISO 8878♦	Information Processing Systems - Data Communications - Use of X.25 to Provide the OSI Connection-Mode Network Service (CONS), September 1987 (X.223)
ISO 8878 DAD 1	Information Processing Systems - Data Communications - Use of X.25 to Provide the OSI Connection-Mode Network Service (CONS), Addendum 1: Protection and Priority, 1989
ISO 8878 DAD 2	Information Processing Systems - Data Communications - Use of X.25 to Provide the OSI Connection-Mode Network Service (CONS), Addendum 2: Use of an X.25 PVC to Provide the OSI CONS, 1989
ISO 8878 PDAD 3	Information Processing Systems - Data Communications - Use of X.25 to Provide the OSI Connection-Mode Network Service (CONS), Addendum 3: Conformance, 1989
ISO 8878 WDAD 4	Information Processing Systems - Data Communications - Use of X.25 to Provide the OSI Connection-Mode Network Service (CONS), Addendum 4: PICS Proforma, 1989
ISO 8879	Information Processing - Text and Office Systems - Standard Generalized Markup Language (SGML), 15 October 1986
ISO 8879/Am1	Information Processing - Text and Office Systems - Standard Generalized Markup Language (SGML) - Amendment 1, 1 July 1988
ISO 8880-1♦	Information Processing Systems - Protocol Combination to Provide and Support the OSI Network Service - Part 1: General Principles, 21 October 1988
ISO 8880-2♦	Information Processing Systems - Protocol Combination to Provide and Support the OSI Network Service - Part 2: Provision and Support of the Connection-Mode Network Services, 21 October 1988
ISO 8880-3♦	Information Processing Systems - Protocol Combination to Provide and Support the OSI Network Service - Part 3: Provision and Support of the Connectionless-Mode Network Service, 21 October 1988
WD 8880-4♦	Information Processing Systems - Protocol Combination to Provide and Support the OSI Network Service - Part 4: Interconnection of OSI Environments, 1989
ISO 8881.3♦	Information Processing Systems - Data Communications - Use of the X.25 Packet Level Protocol (PLP) in Local Area Networks, Third Edition, January 1989
ISO 8882-1♦	Information Processing Systems - X.25-DTE Conformance Testing - Part 1: General Principles, 1989
DP 8882-2♦	Information Processing Systems - X.25-DTE Conformance Testing - Part 2: Data Link Layer Conformance Test Suite, May 1988
DIS 8882-3♦	Information Processing Systems - X.25-DTE Conformance Testing - Part 3: Packet Level Conformance Suite, Third Edition, 1989

DIS 8883	Information Processing Systems - Text Communication - Message Oriented Text Interchange System, Message Transfer Sublayer, Message Interchange Service and Message Transfer Protocol, February 1986 [WITHDRAWN, superceded by ISO 10021-6]
DIS 8884	Information Processing - Text and Office Systems - Keyboards for Multiple Latin-Alphabet Languages - Layout and Operation Using Four Levels, October 1986
ISO 8885♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - General Purpose XID Frame Information Field Content and Format, August 1987
ISO 8885 AD 1♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - General Purpose XID Frame Information Field Content and Format - Addendum 1: Additional Operational Parameters for the Parameter Negotiation Data Link Subfield and Definition of a Multilink Parameter Negotiation Data Link Subfield, 22 March 1988
ISO 8885 DAD 2♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - General Purpose XID Frame Information Field Content and Format - Addendum 2: Start/Stop Transmission, 1989
ISO 8885 PDAD 3♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - General Purpose XID Frame Information Field Content and Format - Addendum 3: Definition of a Private Parameter Negotiation Data Link Layer Subfield, 1989
ISO 8885 PDAD 4♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - General Purpose XID Frame Information Field Content and Format - Addendum 4: Extended Transparency Option, 1989
ISO 8885 PDAD 5♦	Information Processing Systems - Data Communication - High-Level Data Link Control (HDLC) Procedures - General Purpose XID Frame Information Field Content and Format - Addendum 5: Multi-Selective Reject, 1989
ISO 8886.3♦	Information Processing Systems - Data Communication - Data Link Service Definition for Open Systems Interconnection, Third Edition, 1989
ISO 8907♦	Information Processing Systems - Database Language NDL, June 1987
TR 9007	Information Processing Systems - Concepts and Terminology for the Conceptual Schema and the Information Base, July 1987
ISO 9040♦	Information Processing Systems - Open Systems Interconnection - Virtual Terminal (VT) Service - Base Class, Revised Edition, April 1990 [SC21 N 4718]; 1990 Revised Edition incorporates AD1
ISO 9040 AD 1♦	Information Processing Systems - Open Systems Interconnection - Virtual Terminal (VT) Service - Addendum 1: Extended Facility Set, August 1988 [SC21 N 3006]; incorporated into 1990 Revised Edition of ISO 9040
ISO 9040 DAM 2♦	Information Processing Systems - Open Systems Interconnection - Virtual Terminal (VT) Service - Amendment 2: Additional Functional Units Service Specification, July 1990 [SC21 N 4173, 14 December 1989] (IS text expected June 1991)
ISO 9041♦	Information Processing Systems - Open Systems Interconnection - Virtual Terminal (VT) Protocol - Basic Class, Revised Edition, April 1990 [SC21 N 4719]; 1990 Revised Edition incorporates AD1
ISO 9041 AD 1♦	Information Processing Systems - Open Systems Interconnection - Virtual Terminal (VT) Protocol - Addendum 1: Extended Facility Set, March 1989 [SC21 N 3531]; incorporated into 1990 Revised Edition of ISO 9041

ISO 9041 DAM 2♦	Information Processing Systems - Open Systems Interconnection - Virtual Terminal (VT) Protocol - Amendment 2: Additional Functional Units, May 1990 [SC21 N 5031] (IS text expected June 1991)
CD 9041-2♦	Information Processing Systems - Open Systems Interconnection - Virtual Terminal (VT) Protocol - Part 2: VT PICS Proforma, June 1990 [SC21 N 4175, November 1989] (editing meeting scheduled November 1990; DIS text expected January 1991, IS text in January 1992)
DIS 9065	Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) User Agent Sublayer - Interpersonal Messaging User Agent - Message Interchange Formats and Protocols, February 1986 [WITHDRAWN, superceded by ISO 10021]
ISO 9066-1.2♦	Information Processing Systems - Text Communication - Reliable Transfer (RT) - Part 1: Model and Service Definition, Second Edition, September 1989 [SC21 N 3883] (CCITT X.218)
ISO 9066-2.2♦	Information Processing Systems - Text Communication - Reliable Transfer (RT) - Part 2: Protocol Specification, Second Edition, September 1989 [SC21 N 3884] (CCITT X.228)
ISO 9067♦	Information Processing Systems - Data Communication - Automatic Fault Isolation Procedures Using Test Loops, September 1987
DIS 9068♦	Information Processing Systems - Provision of the Connectionless Network Service (CONS) Using ISO 8208, 1989
ISO 9069	Information Processing - SGML Support Facilities - SGML Document Interchange Format (SDIF), 15 September 1988
DIS 9070	Information Processing - SGML Support Facilities - Registration Procedures for Public Text Owner Identifiers, January 1988 (IS text expected in 1990)
DP 9071-1.2	Text and Office Systems - Basic and Optional Requirements - Part 1: Facsimile Equipment, Second Edition, January 1987
DP 9071-2.2	Text and Office Systems - Basic and Optional Requirements - Part 2: Text Communications Terminals, Second Edition, January 1987
ISO 9072-1.2♦	Information Processing Systems - Text Communication - Remote Operations - Part 1: Model, Notation and Service Definition, Second Edition, September 1989 [SC21 N 3881] (CCITT X.219)
ISO 9072-2.2♦	Information Processing Systems - Text Communication - Remote Operations - Part 2: Protocol Specification, Second Edition, September 1989 [SC21 N 3882] (CCITT X.229)
ISO 9074♦	Estelle - A Formal Description Technique Based on an Extended State Transition Model, 15 July 1989
ISO 9074 PDAD1	Estelle - A Formal Description Technique Based on an Extended State Transition Model, Addendum 1: Estelle Tutorial, January 1990 [SC21 N 4230] (DAD expected October 1990: intended to be Annex D (informative) to ISO 9074
ISO 9075♦	Information Processing Systems - Database Language SQL, April 1989 (1989 text incorporates AD1) [SC21 N 3158]
ISO 9075 AD 1	Information Processing Systems - Database Language SQL - Addendum 1: Integrity Enhancements, December 1987
CD 9075.2♦	Information Processing Systems - Database Language SQL2, Draft Second Edition, 25 July 1990 [SC21 N 3155, 25 January 1989] (editing meeting scheduled January 1991)

WD 9075.3♦	Information Processing Systems - Database Language SQL3 (CD text expected June 1992)
ISO 9160	Information Processing Systems - Physical Layer Interoperability Requirements, February 1988
DIS 9234	Industrial Asynchronous Data Link for Two-Way Simultaneous or Two-Way Alternate Mode, 1989
DIS 9241	Information Processing Systems - Visual Display Terminal (VDT) [TC159 SC4/WG5]
DIS 9281	Information Processing Systems - Identification of Picture Coding Methods, May 1987
DIS 9282-1	Information Processing Systems - Coded Representation of Pictures - Part 1: Encoding Principles for Picture Representation in a 7- or 8-Bit Environment, May 1987
DIS 9282-2	Information Processing Systems - Coded Representation of Pictures - Part 2: Encoding Principles for Photographic Images, 1987
DTR 9294	Information Processing - Guidelines for the Management of Software Documentation, Technical Report Type 3, June 1988
ISO 9314-1♦	Information Processing Systems - Fibre Distributed Data Interface (FDDI) - Part 1: Physical Layer Protocol (PHY), 1989
ISO 9314-2♦	Information Processing Systems - Fibre Distributed Data Interface (FDDI) - Part 2: Media Access Control (MAC), 1989
DIS 9314-3♦	Interconnection of Equipment - Fibre Distributed Data Interface (FDDI) - Part 3: Physical Layer Medium Dependent (PMD), October 1988
DIS 9316	Information Processing Systems - Small Computer System Interface (SCSI), July 1987
DIS 9318	Information Processing Systems - Intelligent Peripheral Interface - Physical Level, August 1987
DIS 9324	Information Processing - Storage Module Interfaces, September 1988
ISO 9496.2	Information Processing - Programming Languages - CCITT High Level Language (CHILL), August 1989 (CCITT Z.200)
DIS 9506-1♦	Industrial Automation Systems - Systems Integration and Communications - Manufacturing Message Specification - Part 1: Service Definition, February 1988
DIS 9506-2♦	Industrial Automation Systems - Systems Integration and Communications - Manufacturing Message Specification - Part 2: Protocol Specification, February 1988
DIS 9541-1	Information Processing Systems - Font and Character Information Exchange - Part 1: Introduction, December 1987
DIS 9541-2	Information Processing Systems - Font and Character Information Exchange - Part 2: Registration and Naming Procedures, December 1987
DIS 9541-3	Information Processing Systems - Font and Character Information Exchange - Part 3: Character Identification Method, December 1987
DIS 9541-4	Information Processing Systems - Font and Character Information Exchange - Part 4: Character Collections, December 1987
DIS 9541-5	Information Processing Systems - Font and Character Information Exchange - Part 5: Font Attributes and Character Model, December 1987
DIS 9541-6	Information Processing Systems - Font and Character Information Exchange - Part 6: Font and Character Attribute Subsets and Application, December 1987

DP 9541-7	Information Processing Systems - Font and Character Information Exchange - Part 7: Font Interchange Format, May 1987
ISO 9542♦	Information Processing Systems - Data Communications - End System to Intermediate System Routing Exchange Protocol for Use in Conjunction with the Protocol for Providing the Connectionless-Mode Network Service, Revised Edition, 1989
ISO 9543♦	Information Processing Systems - Information Exchange Between Systems - Synchronous Transmission Signal Quality at DTE/DCE Interfaces, May 1989
DTR 9544	Information Processing - Computer-Assisted Publishing - Vocabulary, December 1986
ISO 9545♦	Information Processing Systems - Open Systems Interconnection - Application Layer Structure (ALS), December 1989 [SC21 N 3825, August 1989]
ISO 9545 WDAD 1♦	Information Processing Systems - Open Systems Interconnection - Application Layer Structure (ALS), Addendum 1: Connectionless Mode Transmission, June 1988 [SC21 N 2470] (CD text expected June 1991)
ISO 9545 WDAD 2.2♦	Information Processing Systems - Open Systems Interconnection - Application Layer Structure (ALS), Addendum 2: Extended Application Layer Structure (XALS), July 1990 [SC21 N 5012] (CD text expected November 1990)
TR 9547	Programming Language Processors - Test Methods - Guidelines for Their Development and Acceptability, April 1988
ISO 9548♦	Information Processing Systems - Open Systems Interconnection - Session Connectionless Protocol to Provide the Connectionless-Mode Session Service, 1989
WD 9548–2	Information Processing Systems - Open Systems Interconnection - Session Connectionless Protocol to Provide the Connectionless-Mode Session Service - Part 2: PICS Proforma, June 1989 [SC21 N 5018] (CD text expected February 1991)
DIS 9549♦	Information Processing Systems - Galvanic Isolation of Balanced Interchange Circuits, 1989
TR 9571♦	Information Processing Systems - Open Systems Interconnection - LOTOS Description of the Session Service, 15 September 1989 [SC21 N 3149, 25 January 1989]
TR 9572♦	Information Processing Systems - Open Systems Interconnection - LOTOS Description of the Session Protocol, 15 September 1989 [SC21 N 3148, 25 January 1989]
TR 9573	Information Processing - SGML Support Facilities - Techniques for Using SGML, 1 December 1988
ISO 9574♦	Information Processing Systems - Data Communications - Provision of the OSI Connection-Mode Network Service (CONS) by Packet Mode Terminal Equipment Connected to an Integrated Services Digital Network (ISDN), May 1988
ISO 9574 WDAD1	Information Processing Systems - Data Communications - Provision of the OSI Connection-Mode Network Service (CONS) by Packet Mode Terminal Equipment Connected to an Integrated Services Digital Network (ISDN) - Addendum 1: Provision of the CONS on an ISDN Circuit-Switch Channel, 1989
TR 9575♦	OSI Routing Framework, June 1989
ISO 9576♦	Information Processing Systems - Open Systems Interconnection - Presentation Protocol to Provide the Connectionless-Mode Presentation Service, 1 June 1990 [SC21 N 4934]

CD 9576–2	Information Processing Systems - Open Systems Interconnection - Presentation Protocol to Provide the Connectionless-Mode Presentation Service - Part 2: PICS Proforma for Connectionless Presentation Protocol, July 1990 [SC21 N 5020] (DIS text expected November 1990, IS text November 1991)
DTR 9577♦	Protocol Identification in the OSI Network Layer, 1989
DTR 9578♦	Communication Interface Connectors Used in Local Area Networks, September 1988
DP 9579-1♦	Information Processing Systems - Database Languages - Remote Database Access (RDA) - Part 1: Generic Model, Service and Protocol, 29 March 1990 [SC21 N 4282] (editing meeting October 1990; CD text expected June 1991)
DP 9579-2♦	Information Processing Systems - Database Languages - Remote Database Access (RDA) - Part 2: SQL Specialization, 29 March 1990 [SC21 N 4281] (editing meeting October 1990; CD text expected June 1991)
DP 9579-2 WDAM 1	Information Processing Systems - Database Languages - Remote Database Access (RDA) - Part 2: SQL Specialization, Amendment 1: Support for SQL 2, 29 March 1990 (CD text expected June 1992)
ISO 9592-1	Information Processing Systems - Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) Language Bindings - Part 1: Functional Description, May 1989
ISO 9592-2	Information Processing Systems - Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) Language Bindings - Part 2: Archive File Format, May 1989
ISO 9592-3	Information Processing Systems - Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) Language Bindings - Part 3: Clear-Text Encoding of Archive File, May 1989
ISO 9593-1	Information Processing Systems - Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) Language Bindings - Part 1: FORTRAN Binding, October 1988
DIS 9593-2	Information Processing Systems - Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) Language Bindings - Part 2: Extended Pascal, 1988
DIS 9593-3	Information Processing Systems - Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) Language Bindings - Part 3: Ada, 1989
DIS 9593-4	Information Processing Systems - Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) Language Bindings - Part 4: C, 1989
ISO 9594-1♦	Information Processing Systems - Open Systems Interconnection - The Directory - Part 1: Overview of Concepts, Models and Services, July 1990 [SC21 N 4701] (CCITT X.500)
ISO 9594-1/7♦	The Directory - Amendments to Parts 1-7, Schema, PCDAMs, July 1990 [SC21 N 4914] (CD text expected October 1990, DIS text in October 1991, and IS text in October 1992)
ISO 9594-1/7♦	The Directory - Amendments to Parts 1-7, Support of Nameform2, PCDAMs (WD text planned for June 1991, CD text in November 1991, DIS text in November 1992, and IS text in November 1993)
ISO 9594-2♦	Information Processing Systems - Open Systems Interconnection - The Directory - Part 2: Models, July 1990 [SC21 N 4702] (CCITT X.501)
ISO 9594-2/4♦	The Directory - Amendments to Parts 2-4, Access Control, CDAMs, May 1990 [SC21 N 4898] (DIS status expected in June 1991 and IS status in June 1992)

ISO 9594-2/5♦	The Directory - Amendments to Parts 2-5, Replication and Knowledge Management, PCDAMs, July 1990 [SC21 N 4913] (CD text expected October 1990, DIS text in October 1991, and IS text in October 1992)
ISO 9594-3♦	Information Processing Systems - Open Systems Interconnection - The Directory - Part 3: Abstract Service Definition, July 1990 [SC21 N 4703] (CCITT X.511)
ISO 9594-3,4	The Directory - Amendments to Parts 3, 4, Enhanced Search, PCDAMs, July 1990 [SC21 N 4924] (CD text planned for October 1990, DIS text in October 1991, and IS text in October 1992)
ISO 9594-4♦	Information Processing Systems - Open Systems Interconnection - The Directory - Part 4: Procedures for Distributed Operations, July 1990 [SC21 N 4704] (CCITT X.518)
ISO 9594-5♦	Information Processing Systems - Open Systems Interconnection - The Directory - Part 5: Protocol Specifications, July 1990 [SC21 N 4705] (CCITT X.519)
ISO 9594-6♦	Information Processing Systems - Open Systems Interconnection - The Directory - Part 6: Selected Attribute Types, July 1990 [SC21 N 4706] (CCITT X.520)
ISO 9594-7♦	Information Processing Systems - Open Systems Interconnection - The Directory - Part 7: Selected Object Classes, July 1990 [SC21 N 4707] (CCITT X.521)
ISO 9594-8♦	Information Processing Systems - Open Systems Interconnection - The Directory - Part 8: Authentication Framework, July 1990 [SC21 N 4708] (CCITT X.509)
WD 9594-9♦	The Directory - Part 9: DIT Structure and Naming, July 1990 [SC21 N 4985] (CD text expected October 1990)
WD 9594-10♦	The Directory - Part 10: Replication and Knowledge Management, July 1990 [SC21 N 4913] (CD text expected October 1990)
WD 9594-11♦	The Directory - Part 11: Directory PICS Proforma, July 1989 [SC21 N 4039] (formal WD text planned for June 1991, CD text in November 1991, DIS text in November 1992, and IS text in November 1993)
WD 9594-X♦	The Directory - Part X: Text Suite Structure and Test Purposes, July 1990 [SC21 N 4951] (new work item; CD text expected 1992)
WD 9594-Y♦	The Directory - Part Y: Abstract Test Suite for the OSI Directory, July 1990 [SC21 N 4951] (new work item; CD text expected 1992)
ISO 9595♦	Information Processing Systems - Open Systems Interconnection - Common Management Information Service (CMIS) Definition, 15 May 1990 [SC21 N 3874, January 190]
ISO 9595 DAD1♦	Information Processing Systems - Open Systems Interconnection - Common Management Information Service (CMIS) Definition, Addendum 1: CancelGet Service, 1 February 1990 [SC21 N 3876, 28 September 1989] (IS text expected November 1990)
ISO 9595 DAD2♦	Information Processing Systems - Open Systems Interconnection - Common Management Information Service (CMIS) Definition, Addendum 2: Add/Remove Service, 1 February 1990 [SC21 N 3877, 28 September 1989] (IS text expected November 1990)
ISO 9595 PCDAM3♦	Information Processing Systems - Open Systems Interconnection - Common Management Information Service (CMIS) Definition, Amendment 3: Support of Allomorphism, July 1990 [SC21 N 4966] (CD text expected November 1990)

ISO 9595 PCDAM4♦ Information Processing Systems - Open Systems Interconnection - Common Management Information Service (CMIS) Definition, Amendment 4: Access Control, 20 May 1990 [SC21 N 4999] (CD text expected November 1990)

ISO 9596♦ Information Processing Systems - Open Systems Interconnection - Common Management Information Protocol (CMIP) Specification, 15 May 1990 [SC21 N 3875, January 1990]

ISO 9596 DAD1♦ Information Processing Systems - Open Systems Interconnection - Common Management Information Protocol (CMIP) Specification, Addendum 1: CancelGet Service, 1 February 1990 [SC21 N 3878, 28 September 1989] (IS text expected November 1990)

ISO 9596 DAD2♦ Information Processing Systems - Open Systems Interconnection - Common Management Information Protocol (CMIP) Specification, Addendum 2: Add/Remove Service, 1 February 1990 [SC21 N 3879, 28 September 1989] (IS text expected November 1990)

ISO 9596 PCDAM3♦ Information Processing Systems - Open Systems Interconnection - Common Management Information Protocol (CMIP) Specification, Amendment 3: Support of Allomorphism, July 1990 [SC21 N 4967] (CD text expected November 1990)

ISO 9596 PCDAM 4♦ Information Processing Systems - Open Systems Interconnection - Common Management Information Protocol (CMIP) Specification, Amendment 4: State Table, January 1990 [SC21 N 4058] (new work item; CD text expected July 1991)

WD 9596-2♦ Information Processing Systems - Open Systems Interconnection - Common Management Information Protocol (CMIP) Specification, Part 2: PICS Proforma, July 1990 [SC21 N 4965] (CD text expected November 1990)

DIS 9636-1 Information Processing Systems - Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 1: Overview, Profiles, and Conformance, 1989

DIS 9636-2 Information Processing Systems - Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 2: Control, Negotiation, and Errors, 1989

DIS 9636-3 Information Processing Systems - Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 3: Output and Attributes, 1989

DIS 9636-4 Information Processing Systems - Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 4: Segmentation, 1989

DIS 9636-5 Information Processing Systems - Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 5: Input and Echoing, 1989

DIS 9636-6 Information Processing Systems - Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 6: Raster, 1989

WD 9636-8 Information Processing Systems - Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 8: FORTRAN Language Binding of CGI, 1989

WD 9636-11 Information Processing Systems - Computer Graphics - Interfacing (CGI) Techniques for Dialogues with Graphical Devices - Functional Specification - Part 11: C Language Binding of CGI, 1989

DIS 9646-1.2♦ Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 1: General Concepts, Second Edition, April 1989 [SC21 N 3429] (IS text expected September 1990) (CCITT X.290)

DIS 9646-2.2♦	Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 2: Abstract Test Suite Specification (Excluding Annexes E and F on TTCN), April 1989 [SC21 N 3430] (IS text expected September 1990)
DP 9646-2 WDAD1	Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 2: Abstract Test Suite Specification, Addendum 1: Testing and Formal Description Techniques (FDTs)
DIS 9646-3♦	Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 3: The Tree and Tabular Combined Notation (TTCN), May 1990 (revised DIS text to be developed November-December 1990)
DIS 9646-3 WDAD1	Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 3: The Tree and Tabular Combined Notation (TTCN), Addendum 1: TTCN Extensions, July 1990 [SC21 N 5077] (CD text expected June 1991)
DIS 9646-4♦	Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 4: Test Realization, 1989 [SC21 N 3504, June 1989] (IS text expected September 1990)
DIS 9646-5♦	Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 5: Requirements on Test Laboratories and Clients for the Conformance Assessment Process, 1989 [SC21 N 3503, April 1989] (IS text expected September 1990)
DP 9646-6	Information Processing Systems - OSI Conformance Testing Methodology and Framework - Part 6: Interpretation of Test Report
ISO 9660	Information Processing - Volume and File Structure of CD-ROM for Information Exchange, April 1988
ISO 9735	Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) - Application Level Syntax Rules, July 1988
DIS 9796	Information Processing - Digital Signature Scheme Giving Message Recovery, 1989
ISO 9797	Information Processing - Data Cryptographic Techniques - Data Integrity Mechanisms Using a Cryptographic Check Function Employing a Block Cypher Algorithm, 1989
DIS 9798-1	Information Processing - Entity Authentication Mechanisms - Part 1: General Model
DP 9798-2	Information Processing - Entity Authentication Mechanisms - Part 2: Entity Authentication Mechanisms Using Symmetric Algorithms
ISO 9804♦	Information Processing Systems - Open Systems Interconnection - Service Definition for the Commitment, Concurrency, and Recovery (CCR) Service Element, July 1990 [SC21 N 4611, 20 April 1990] (CCITT X.237)
ISO 9804 CDAM1♦	Information Processing - Open Systems Interconnection - Service Definition for the Commitment, Concurrency, and Recovery (CCR) Service Element, Amendment 1: Enhancements, 1 June 1990 [SC21 N 5119] (DIS text expected May 1991, IS text May 1992)
ISO 9804 WDAM2	Information Processing - Open Systems Interconnection - Service Definition for the Commitment, Concurrency, and Recovery (CCR) Service Element, Amendment 2: Session Mapping Changes (Additional Resynchronization Functionality), July 1990 [SC21 N 5122] (CD text expected November 1990)
ISO 9804 WDAM3♦	Information Processing - Open Systems Interconnection - Service Definition for the Commitment, Concurrency, and Recovery (CCR) Service Element, Amendment 3: Restart (CD text expected May 1992)

ISO 9805♦	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Protocol, July 1990 [SC21 N 4612, 20 April 1990] (CCITT X.247)
ISO 9805 CDAM1♦	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Protocol, Amendment 1: Enhancements, 1 June 1990 [SC21 N 5120] (DIS text expected May 1991, IS text May 1992)
ISO 9805 WDAM2	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Service Element, Amendment 2: Session Mapping Changes (Additional Resynchronization Functionality), July 1990 [SC21 N 5123] (CD text expected November 1990)
ISO 9805 WDAM3♦	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Protocol, Amendment 3: Restart (CD text expected May 1992)
CD 9805-2♦	Information Processing Systems - Open Systems Interconnection - Protocol Specification for the Commitment, Concurrency, and Recovery (CCR) Protocol - Part 2: CCR PICS Proforma, 16 July 1990 [SC21 N 5121] (DIS text expected November 1991, IS text November 1992)
DIS 9834-1♦	Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part 1: General Procedures, March 1990 [SC21 N 4352] (DIS ballot suspended and reissued in August 1990)
DIS 9834-2♦	Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part 2: Registration Procedures for OSI Document Types, 1990 [SC21 N 2605, May 1988] (DIS ballot suspended and reissued in August 1990; IS text expected in June 1991)
ISO 9834-3♦	Information Processing Systems - Open Systems Interconnection - Procedures for OSI Registration Authorities - Part 3: Procedures for Specific Registration of Joint Object Identifier Component Values for Joint ISO-CCITT Use, April 1990 [SC21 N 4718]
DIS 9834-4♦	Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part 4: Registration of VT Profiles, March 1990 [SC21 N 4325, 10 January 1990] (DIS ballot suspended and reissued in August 1990; IS text expected July 1991)
DIS 9834-5♦	Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part 5: Register of VT Control Object Identifiers, March 1990 [SC21 N 4322, 10 January 1990] (DIS ballot suspended and reissued in August 1990; IS text expected July 1991)
DP 9834-6♦	Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part 6: Registration Authority Procedures for Application Process Titles and Application Entity Titles, July 1990 [SC21 N 5218] (DIS text expected August 1990)
WD 9834-B	Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part B: Registration of Abstract Syntaxes, 1990
WD 9834-C	Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part C: Registration of Transfer Syntaxes, 1990
WD 9834-D	Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part D: Registration of Application Contexts, 1990 (work suspended by SC21, November 1989)

WD 9834-E	Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part E: Registration of System Titles, 1990 (will probably be incorporated in OSI management standards)
WD 9834-F	Information Processing Systems - Open Systems Interconnection - Procedures for Specific OSI Registration Authorities - Part F: Registration of Authentication Mechanisms, 1990 (WITHDRAWN; cancelled by SC21, November 1989)
ISO 9945-1	Portable Operating System Interface for Computer Environments (POSIX) - Part 1: System Interface, 1990
DP 9945-2	Portable Operating System Interface for Computer Environments (POSIX) - Part 2: Shell and Utilities, 1989
TR 9973	Registration of Graphical Items, 1989
ISO 9979	Information Processing - Data Encipherment - Procedures for the Registration of Cryptographic Algorithms, July 1990 [SC27 N 88]
DIS 9995-30	Information Processing - Keyboard Layouts for Text and Office Systems - Part 30: Numeric Section, October 1988
DIS 9995-31	Information Processing - Keyboard Layouts for Text and Office Systems - Part 31: Numeric Zone of the Numeric Section, October 1988
DIS 9995-41	Information Processing - Keyboard Layouts for Text and Office Systems - Part 30: Function Zones of the Numeric Section, October 1988
TR 10000-1♦	Information Processing Systems - International Standardized Profiles (ISPs) - Part 1: Taxonomy Framework, 9 February 1990 [SGFS N 184]
TR 10000-2♦	Information Processing Systems - International Standardized Profiles (ISPs) - Part 2: Taxonomy of Profiles, 9 February 1990 [SGFS N 185]
ISO 10021-1♦	Information Processing - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 1: System and Service Overview, June 1988 (see CCITT X.400)
ISO 10021-2♦	Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 2: Overall Architecture, June 1988 (see CCITT X.402)
ISO 10021-3♦	Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 3: Abstract Service Definition Conventions, June 1988 (see CCITT X.407)
ISO 10021-4♦	Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 4: Message Transfer System: Abstract Service Definition and Procedures, June 1988 (see CCITT X.411)
ISO 10021-5♦	Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 5: Message Store: Abstract Service Definition, June 1988 (see CCITT X.412)
ISO 10021-6♦	Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 6: Protocol Specifications, June 1988 (see CCITT X.419)
ISO 10021-7♦	Information Processing Systems - Text Communication - Message Oriented Text Interchange System (MOTIS) - Part 7: Interpersonal Messaging System, June 1988 (see CCITT X.420)
DIS 10022♦	Information Processing Systems - Open Systems Interconnection - Physical Service Definition, September 1988 (CCITT X.211)

PDTR 10023♦	Telecommunications and Information Exchange Between Systems - A Formal Description of ISO 8072 in LOTOS, March 1988
TR 10024	Information Processing Systems - Data Communications - Operation of an X.25 Interworking Unit, 5 December 1988.
PDTR 10024♦	Telecommunications and Information Exchange Between Systems - A Formal Description of ISO 8073 in LOTOS, April 1988
DIS 10025-1♦	Information Processing Systems - Transport Conformance Testing for Connection Oriented Transport Protocol Operating Over the Connection Oriented Network Service (CONS) - Part 1: General Principles, 1989
DP 10025-2♦	Information Processing Systems - Transport Conformance Testing for Connection Oriented Transport Protocol Operating Over the Connection Oriented Network Service (CONS) - Part 2: Test Suite Structure and Test Principles, 1989
DP 10025-3♦	Information Processing Systems - Transport Conformance Testing for Connection Oriented Transport Protocol Operating Over the Connection Oriented Network Service (CONS) - Part 3: Abstract Test Suite Specification, 1989
DIS 10026-1♦	Distributed Transaction Processing (TP) - Part 1: Model, 22 March 1990 [SC21 N 4288, 15 December 1989] (editing meeting November-December 1990; IS text expected June 1991)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Transaction Processing Security, WDAMs, January 1990 [SC21 N 4163] (CD text expected June 1992)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Transaction Processing Association Management, WDAMs, January 1990 [SC21 N 4164] (CD text expected June 1992)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Transaction Processing Heuristic Decisions, WDAMs, January 1990 [SC21 N 4167] (CD text expected June 1992)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Transaction Processing Commitment Optimization, WDAMs, January 1990 [SC21 N 4168] (CD text expected June 1991)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Distributed Transaction Processing Dialogue Recovery and User Suspension of a Dialogue, WDAMs, January 1990 [SC21 N 4170] (CD text expected June 1992)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Distributed Transaction Processing Savepoints, January 1990 [SC21 N 4171] (new work item; not accepted by JTC1, June 1990)
DIS 10026-1/3	Draft Amendments to Parts 1-3: Transaction Processing Sub-Transactions, SC21/WG5, WDAMs, July 1990 [SC21 N 5156] (new work item; CD text expected January 1992)
DIS 10026-1/4	Draft Amendments to Parts 1-3: Transaction Processing Separate Data and Commit Associations, WDAMs, July 1990 [SC21 N 5157] (new work item; CD text expected January 1993)
DIS 10026-2♦	Information Processing Systems - Open Systems Interconnection - Distributed Transaction Processing (TP) - Part 2: Service Definition, 22 March 1990 [SC21 N 4290] (editing meeting November-December 1990; IS text expected June 1991)
DIS 10026-3♦	Information Processing Systems - Open Systems Interconnection - Distributed Transaction Processing (TP) - Part 3: Transaction Processing Protocol Specification, 22 March 1990 [SC21 N 4292] (editing meeting November-December 1990) (editing meeting November-December 1990; IS text expected June 1991)
CD 10026-4	Information Processing Systems - Open Systems Interconnection - Distributed Transaction Processing (TP) - Part 4: PICS Proforma, SC21/WG5, 14 July 1990 [SC21 N 5159] (editing meeting scheduled January 1991; DIS text expected June 1991, IS text in June 1992)

CD 10026-5	Information Processing Systems - Open Systems Interconnection - Distributed Transaction Processing (TP) - Part 5: Application Context Proforma, SC21/WG5, July 1990 [SC21 N 5160] (CD text expected June 1990, DIS text in June 1991, IS text in June 1992)
WD 10026-Y	Data Transfer for OSI TP - Unstructured Data Transfer, January 1990 [SC21 N 4166] (new work item; CD text expected June 1991)
WD 10026-Z	Data Transfer for OSI TP - Other Transfer Modes, January 1990 [SC21 N 4166] (new work item; CD text expected June 1992]
ISO 10027	Information Technology - Information Resource Dictionary System (IRDS) Framework, 2 May 1990 [SC21 N 4727]
DP 10028.2♦	Definition of the Relaying Functions of a Network Layer Intermediate System, June 1989
TR 10029♦	Information Processing Systems - Data Communications - Operation of an X.25 Interworking Unit, 15 March 1989
DIS 10030♦	Information Processing Systems - Open Systems Interconnection - End System to Intermediate System Routing Information Exchange Protocol for Use in Conjunction with ISO 8208 (X.25 PLP) [SC6 N 5006], 1989
DIS 10031-1	Information Processing - Text Communication - Distributed-Office-Applications Model (DOAM) - Part 1: General Model, April 1989
DIS 10031-2	Information Processing - Text Communication - Distributed-Office-Applications Model (DOAM) - Part 2: Referenced Data Transfer, April 1989
CD 10032.2♦	Information Processing Systems - Reference Model of Data Management, July 1990 [SC21 N 2641, May 1988] (editing meeting scheduled January 1991)
DP 10033	Information Processing - Text and Office Systems - Recording of Documents Conforming to ISO 8613 on Flexible Disk Cartridges Conforming to ISO 9293, May 1988
DTR 10034	Guidelines for the Preparation of Conformity Clauses in Programming Language Standards (Technical Report, Type 3), July 1988
ISO 10035♦	Information Processing Systems - Open Systems Interconnection Connectionless ACSE Protocol Specification, 1 June 1990 [SC21 N 4938]
WD 10035-2	Information Processing Systems - Open Systems Interconnection Connectionless ACSE Protocol Specification - Part 2: PICS Proforma for Connectionless ACSE Protocol, July 1989 [SC21 N 3218] (CD text possible in June 1991)
DTR 10037	Information Processing - SGML and Text-Entry Systems - Guidelines for SGML Syntax-Directed Editing Systems, September 1988
DP 10038♦	Information Processing Systems - Local Area Networks - MAC Sublayer Interconnection (MAC Bridging), October 1988
DIS 10039♦	Information Processing Systems - Local Area Networks - MAC Service Definition, September 1989
DIS 10040♦	Information Processing Systems - Open Systems Interconnection - Systems Management Overview, July 1990 [SC21 N 4865] (IS text expected July 1991)
DIS 10116	Information Processing - Modes of Operation for an N-bit Block Cipher Algorithm, 1989 [SC27 N 86]
DIS 10148	Information Processing Systems - Basic Remote Procedure Call (RPC) Using OSI Remote Operations, 9 March 1989 [SC21 N 3463; fast-track ballot failed; DIS 10148 WITHDRAWN; proposal for new work item, SC21 N 4153, January 1990] (CD text for RPC model, service, and protocol now planned for June 1991)

DIS 10149	Information Processing Systems - Data Interchange on Read-Only 120-mm Optical Data Disks (CD-ROM), August 1988
DIS 10164-1♦	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 1: Object Management Function, July 1990 [SC21 N 4855] (IS text expected July 1991)
DIS 10164-2♦	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 2: State Management Function, July 1990 [SC21 N 4068, December 1989] (IS text expected July 1991)
DIS 10164-3♦	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 3: Relationship Management Function, July 1990 [SC21 N 4069, December 1989] (IS text expected July 1991)
DIS 10164-4♦	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 4: Alarm Reporting Function, July 1990 [SC21 N 4070, December 1989] (IS text expected July 1991)
DIS 10164-5♦	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 5: Event Report Management Function, July 1990 [SC21 N 4071, December 1989] (IS text expected July 1991)
DIS 10164-6♦	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 6: Log Control Function, July 1990 [SC21 N 4063, December 1989] (IS text expected July 1991)
DIS 10164-7♦	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 7: Security Alarm Reporting Function, July 1990 [SC21 N 4064, December 1989] (IS text expected July 1991)
CD 10164-8	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 8: Security Audit Trail Function, July 1990 [SC21 N 4955] (DIS text expected April 1991)
CD 10164-9	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 9: Objects and Attributes for Access Control, July 1990 [SC21 N 4956] (DIS text expected April 1991)
CD 10164-10	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 10: Accounting Meter Function, July 1990 [SC21 N 4958] (DIS text expected April 1991)
CD 10164-11	Information Processing Systems - Open Systems Interconnection - Systems Management - Part 11: Workload Monitoring Function, July 1990 [SC21 N 4959] (DIS text expected April 1991)
WD 10164-X	Information Processing Systems - Open Systems Interconnection - Systems Management - Part X: Software Management Function, July 1990 [SC21 N 4978] (CD text expected July 1992)
WD 10164-Y	Information Processing Systems - Open Systems Interconnection - Systems Management - Part Y: Test Management Function, July 1990 [SC21 N 4978] (CD text expected November 1990)
WD 10164-Z	Information Processing Systems - Open Systems Interconnection - Systems Management - Part Z: Confidence and Diagnostic Test Classes, July 1990 [SC21 N 4957] (CD text expected November 1990)
WD 10164-A	Information Processing Systems - Open Systems Interconnection - Systems Management - Part A: Time Management Function, July 1990 [SC21 N 4953] (new work item; standard will have two parts: representation of time and mechanisms for the distribution and synchronization of time; CD text for representation of time expected November 1991)

WD 10164-B	Information Processing Systems - Open Systems Interconnection - Systems Management - Part B: Measurement Summarization Function, Second Working Draft, July 1990 [SC21 N 4972] (CD text expected November 1990)
DIS 10165-1♦	Information Processing Systems - Open Systems Interconnection - Structure of Management Information - Part 1: Management Information Model, July 1990 [SC21 N 4484] (IS text expected July 1991)
DIS 10165-2♦	Information Processing Systems - Open Systems Interconnection - Structure of Management Information - Part 2: Definition of Management Information, July 1990 [SC21 N 4867] (IS text expected August 1991)
DIS 10165-4♦	Information Processing Systems - Open Systems Interconnection - Structure of Management Information - Part 4: Guidelines for the Definition of Managed Objects, July 1990 [SC21 N 4852] (IS text expected July 1991)
DIS 10166-1	Document Filing and Retrieval (DFR) - Part 1: Abstract Service Definition and Procedures, 14 December 1989 [SC18 N 2069, February 1989]
DIS 10166-2	Document Filing and Retrieval (DFR) - Part 2: Protocol Specification, 14 December 1989 [SC18 N 2070, February 1989]
TR 10167♦	Information Processing Systems - Open Systems Interconnection - Draft Technical Report on Guidelines for the Application of Estelle, LOTOS, and SDL, 18 January 1990 [SC21 N 4259]
DIS 10168-1♦	Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the Session Protocol - Part 1: Test Suite Structure and Test Purposes, 19 April 1990 [SC21 N 4159, 11 December 1989]
WD 10168-2♦	Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the Session Protocol - Part 2: Generic Test Suite, 1989 (CD text expected June 1992)
WD 10168-3♦	Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the Session Protocol - Part 3: Abstract Test Suite for CS Method, 1989 (CD text June 1991)
DIS 10168-4♦	Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the Session Protocol - Part 4: Session Test Management Protocol Specification, July 1990 [SC21 N 5026] (IS text expected June 1991)
DIS 10169-1♦	Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the ACSE Protocol - Part 1: Test Suite Structure and Test Purposes, February 1989 [SC21 N 3219] (IS text expected June 1991)
DIS 10170-1♦	Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the FTAM Protocol - Part 1: Test Suite Structure and Test Purposes, July 1990 [SC21 N 4181, 11 December 1989] (IS text expected June 1991)
WD 10170-2♦	Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the FTAM Protocol - Part 2: FTAM Abstract Test Suite, June 1989 [SC21 N 3665] (CD text expected June 1991)
WD 10170-3♦	Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the FTAM Protocol - Part 3: ACSE Abstract Test Suite Embedded Under FTAM, 1989 (CD text expected June 1992)
WD 10170-4♦	Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the FTAM Protocol - Part 4: Presentation Abstract Test Suite Embedded Under FTAM, 1989 (CD text expected June 1992)

WD 10170-5♦	Information Processing Systems - Open Systems Interconnection - Conformance Test Suite for the FTAM Protocol - Part 5: Session Abstract Test Suite Embedded Under FTAM, 1989 (CD text expected June 1992)
DTR 10171♦	List of Standard Data Link Layer Protocols That Utilize HDLC Classes of Procedures, March 1989
PDTR 10172	Information Processing Systems - Data Communications - Network/Transport Protocol Interworking Specification, 29 March 1990 [SC6 N 5906]
DP 10173	ISDN Primary Access Connector at Reference Points S and T, July 1989
ISO 10177	Information Processing Systems - Data Communications - Intermediate-System Support of the OSI Connection-Mode Network Service Using ISO 8208 in Accordance with ISO 10028, 13 October 1989.
WD 10181-1♦	Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 1: Overview, June 1990 [SC21 N 5044] (CD text expected June 1991)
DP 10181-2♦	Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 2: Authentication Framework, July 1990 [SC21 N 5044]
WD 10181-3♦	Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 3: Access Control Framework, July 1990 [SC21 N 5045] (CD text expected October 1990)
WD 10181-4♦	Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 4: Non-Repudiation Framework, July 1990 [SC21 N 5046] (CD text expected June 1991)
WD 10181-5♦	Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 5: Confidentiality Framework, June 1990 [SC21 N 5048] (CD text expected June 1991)
WD 10181-6♦	Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 6: Integrity Framework, July 1990 [SC21 N 5047] (CD text expected June 1991)
WD 10181-7	Information Processing Systems - Open Systems Interconnection - Security Frameworks in Open Systems - Part 7: Audit Trail Framework, December 1988 [SC21 N 3338]
CD 10184-1	Terminal Management - Model, June 1990 [SC21 N 4176] (editing meeting November 1990)
WD 10184-2	Terminal Management - Service, June 1990 [SC21 N 4176] (formal WD text expected November 1990, CD text expected November 1991)
WD 10184-3	Terminal Management - Protocol, June 1990 [SC21 N 4176] (formal WD text expected November 1990, CD text expected November 1991)
DISP 10607-1	Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 1: Specification of ACSE, Presentation and Session Protocols for the Use by FTAM, 26 April 1990 [SGFS N 210] (submitted by SPAG)
DISP 10607-2	Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 2: Definition of Document Types, Constraint Sets and Syntaxes, 26 April 1990 [SGFS N 210] (submitted by SPAG)
DISP 10607-3	Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 3: AFT 11 - Simple File Transfer Service (Unstructured), 26 April 1990 [SGFS N 210] (submitted by SPAG)

DISP 10607-4	Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 4: AFT 12 - Positional File Transfer Service, 17 July 1990 [SGFS N 246]
DISP 10607-4 DAD1	Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 4: AFT 12 - Positional File Transfer Service, Addendum 1: Additional Definitions, 17 July 1990 [SGFS N 245]
DISP 10607-5	Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 5: AFT 22 - Positional File Access Service, 17 July 1990 [SGFS N 247]
DISP 10607-6	Information Technologies - International Standard Profile - AFT nn - File Transfer, Access, and Management - Part 6: AFT 12 - File Management Service, 17 July 1990 [SGFS N 248]
DP 10646	Information Processing - Multiple Octet Coded Character Set, SC27, 14 November 1989 [SC21 N 4627]
JTC1 N 474	Proposal for a New Work Item: OSI Upper Layers Security Model, 21 July 1989
JTC1 N 535	Directives for the Work of ISO/IEC Joint Technical Committee 1 (JTC1) on Information Technology, Secretariat, 31 August 1989
JTC1 N 598	JTC1 Strategic Plan, Editing Team, 20 November 1989
SGFS N 151	CCITT Liaison Statement on Work of SGFS, 6 November 1989 (includes X.220)
SGFS N 201	Information Processing Systems - International Standardized Profiles - Taxonomy Update, ISP Approval, and Maintenance Process, 7 May 1990 (standing SGFS document)
SGFS N 219	An Example of T-Profiles Multi-Part ISP Structure, 11 June 1990
SGFS N 224	Documents Relating to Applications Portabilty Profile Work from JTC1/TSG-1, 11 June 1990
SGFS N 225	Resolutions of JTC1 Advisory Group, 11 June 1990
SGFS N 226	Liaison Statement to JTC1 on Multi-Part ISDN ISP Structures, 11 June 1990
SGFS N 228	Liaison Statement to JTC1 SGFS on the Inclusion of a Profile for MMS in the Taxonomy of Profiles TR 100000-2, 11 June 1990
SGFS N 229	Resolutions of the 3rd Regional Workshop Coordinating Committee Meeting; AOW - EWOS - NIST OIW, 11 June 1990
SGFS N 236	EWOS Organization and Activities, 11 June 1990
SC21 SD-1	Report of the Secretariat to the Plenary Meeting of ISO/IEC JTC1 SC21, 5-6 June 1990, Seoul, Republic of Korea, SC21 Secretariat, 12 April 1990 [SC21 N 4588] (provides terms of reference and points of contact for working groups)
SC21 SD-2	ISO/IEC JTC1 SC21 Programme of Work (POW) - Target Date Summary for All Active and Published Projects, SC21 Secretariat, April 1990
SC21 SD-8	SC21 Schedule of Meetings, 19 June 1990 [SC21 N 5216]
SC21 SD-9	Approved Commentaries on the Basic Reference Model for Open System Interconnection, OSI Reference Model Editor, 19 June 1990 [SC21 N 5217]
CD xxxx-1♦	Basic Reference Model for Open Distributed Processing - Part 1: Introduction (proposal for new work item, 1987) [SC21 N 1547] (CD text expected June 1994)

CD xxxx-2♦	Basic Reference Model for Open Distributed Processing - Part 2: Concepts and Modelling Tools (proposal for new work item, 1987) [SC21 N 1547] (CD text expected June 1992)
CD xxxx-3♦	Basic Reference Model for Open Distributed Processing - Part 3: Framework for ODP Standards (proposal for new work item, 1987) [SC21 N 1547] (CD text expected May 1993)
CD xxxx-4♦	Basic Reference Model for Open Distributed Processing - Part 4: User Guide (proposal for new work item, 1987) [SC21 N 1547] (CD text expected May 1994)
CD xxxx-1♦	Conformance Test Suite for the Presentation Protocol, Part 1: Test Suite Structure and Test Purposes for the Presentation Protocol, SC21/WG6, July 1990 [SC21 N 5019] (DIS text expected in November 1990, IS text November 1991)
CD xxxx	A Formal Description of the Transport Service Definition in Estelle
CD xxxx	A Formal Description of the Transport Protocol Specification in Estelle
CD xxxx	Transport Layer Management
CD xxxx	Transport Layer Security
CD xxxx♦	Information Resource Dictionary System (IRDS) Services Interface, July 1990 [SC21 N 5147] (editing meeting January 1991)
CD xxxx-1	Information Technology - Open Systems Interconnection - Conventions for Service Definitions - Part 1: General Model and Conventions (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supercede TR 8509)
CD xxxx-2	Information Technology - Open Systems Interconnection - Conventions for Service Definitions - Part 2: Application Layer (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supercede TR 8509)
CD xxxx-3	Information Technology - Open Systems Interconnection - Conventions for Service Definitions - Part 3: Layers 1-6 (proposal for new work item, July 1990 [SC21 N 5101] (editing meeting scheduled January 1991; will supercede TR 8509)
WD xxxx-1	Conformance Test Suite for the TP Protocol, Part 1: Test Suite Structure and Test Purposes, 6th Working Draft, June 1990 [SC21 N 5162] (formal WD text expected in February 1991, CD text in June 1992)
WD xxxx-2	Conformance Test Suite for the TP Protocol, Part 2: Abstract Test Suites, January 1990 [SC21 N 4172]
WD xxxx	Multi-Party Testing Methodology, SC21/WG1, July 1990 [SC21 N 5076] (CD text expected October 1990)
WD xxxx	Information Resource Dictionary System (IRDS) - Design Support for SQL Applications (CD text expected January 1991)
WD xxxx	Information Resource Dictionary System (IRDS) - Export/Import (CD text expected November 1990)
WD xxxx	Information Resource Dictionary System (IRDS) - Extensions, July 1990 [SC21 N 5139] (CD text expected June 1992)
WD xxxx	Registration of System Titles (DP expected November 1990)
WD xxxx	Service and Protocol for Authentication Exchange Application Service Element (ASE), January 1990 [SC21 N 4110] (WD expected October 1990, CD expected June 1992; collaborative work with CCITT SG VII)
WD xxxx-1	Cryptographic Mechanisms for Key Management, Part 1: Key Management Overview [SC27/WG2]

WD xxxx-2	Cryptographic Mechanisms for Key Management, Part 2: Key Management Using Secret Key Techniques [SC27/WG2]
WD xxxx-3	Cryptographic Mechanisms for Key Management, Part 3: Key Management Using Public Key Techniques [SC27/WG2]
WD xxxx-4	Cryptographic Mechanisms for Key Management, Part 4: Key Management Using Public Key Register [SC27/WG2]
CDTR xxxx	Information Processing - Methodology and Guidelines for the Development of Application Layer Protocols, June 1990 [SC21 N 4903] (new work item of June 1988 failed but programme of work with CDTR is still active; status uncertain)
CDTR xxxx♦	Information Technology - Open Systems Interconnection - Tutorial on Naming and Addressing, July 1990 [SC21 N 5102]
WDTR xxxx	Systems Management Tutorial, July 1990, SC21/WG4 [SC21 N 4942] (CCITT X.702)
WDTR xxxx, Ann A	Systems Management Tutorial - Annex A: Access Control, 30 May 1990 [SC21 N 4970]
WDTR xxxx	Application Layer Guidelines, November 1989 [SC21 N 3206, December 1988] (CD text expected in 1990)
WDTR xxxx	Tutorial on the Reference Model for Data Management (PDTR expected June 1992)
WDTR xxxx♦	Architectural Semantics for FDTs (new work item, October 1987) [SC21 N 2010]
WDTR xxxx♦	Formal Description of ISO 8473
WDTR xxxx♦	Information Processing Systems - Open Systems Interconnection - Remote Database Access (RDA) Tutorial, January 1989 [SC21 N 3343] (CD text expected June 1991)
WDTR xxxx	Catalogue of PICS Proforma Notations, July 1990 (joint work of WG1 and CCITT SG VII; meeting scheduled for February 1991)
SC6 N 4053	End System to Intermediate System Routing Exchange Protocol for Use in Conjunction with ISO 8473
SC 6 N 4782	An Architectural Framework for Private Networks, Pre-Publication Version of ECMA TR 44, December 1987
SC 6 N 5006	End System to Intermediate System Routing Exchange Protocol for Use in Conjunction with ISO 8208 (X.25/PLP), May 1988
SC6 N 5447	Liaison Statement to SC21/WG4 on Lower Layer Management, 13 October 1990
SC6 N 5784	General Principles for the Definition of Lower Layer Management, 2nd Draft, JTC1 SC6/WG2/WG4, April 1990
SC21 N 197	Concepts and Terminology for the Conceptual Schema and the Information Base, TC97/SC5, March 1982
SC21 N 236	Assessment Guidelines for Conceptual Schema Language Proposals, TC97/SC21/WG5-3, 31 August 1985
SC21 N 1889	ODP: Proposed Revised Text for the NWI on the Basic Reference Model of Open Distributed Processing, 29 April 1987
SC21 N 2507	ODP: Report on Topic 1 - The Problem of Distributed Processing, March 1988 [SC21/WG7]
SC21 N 2511	ODP: Definitions and Glossary - March 1988 Version, March 1988 [SC21/WG7]
SC21 N 3109	Architectural and Descriptive Issues Identified During the Workshop on Application Layer Standardization, December 1988 [SC21/WG1]

SC21 N 3122	Informal Guide for ISO/IEC JTC1 and CCITT Cooperation, 15 January 1989
SC21 N 3132	TTCN Operational Semantics, November 1988
SC21 N 3141	Response to SC21 N 2864, Issues Concerning the Requirements for Security Services in the Presentation Layer, November 1988 [SC21/WG1]
SC21 N 3158	Database Language SQL2 With Integrity Enhancement, January 1989 [SC21/WG3]
SC21 N 3167	Response to SC18 Liaison on Encryption, January 1989 [SC21/WG3]
SC21 N 3174	Working Document on ASN.1, Including Timetable, March 1989 [SC21/WG6]
SC21 N 3180	Possible CCR Extensions - Base Text, January 1989 [SC21/WG6]
SC21 N 3194	ODP: Working Document on Topic 2.3 - Framework of Abstractions, December 1988 [SC21/WG7]
SC21 N 3202	ODP: Recommendations of SC21/WG7, Sydney, 9 December 1988
SC21 N 3205	Proposed Modus Operandi and Programme of Work of SC21/WG6 ULA Rapporteur Group, December 1988 [SC21/WG6]
SC21 N 3207	Relationship Between Objects in Peer Open Systems, December 1988 [SC21/WG6]
SC21 N 3208	Requirements for More efficient Use of Application Associations, December 1988 [SC21/WG6]
SC21 N 3209	Upper Layer Security Model, July 1989 (WD expected October 1990 and CD June 1991; collaborative work with CCITT SG VIII)
SC21 N 3251	Working Draft on Architectural Semantics for FDTs, December 1988 [SC21/WG1]
SC21 N 3266	Guide for Open Systems Security, December 1988 [SC21/WG1]
SC21 N 3267	Plan for Work on Security in SC21, December 1988 [SC21/WG1]
SC21 N 3283	Working Draft for Lower-Layer Security Model, December 1988 [SC21/WG1]
SC21 N 3288	ODP: Working Document on Topic 2.2 - Properties and Design Freedoms, December 1988 [SC21/WG7]
SC21 N 3307	WG4 Architecture Issues List, December 1988 [SC21/WG4]
SC21 N 3311 ♦	Configuration Management Overview, December 1988 [SC21/WG4]
SC21 N 3316	Access Control for OSI Management and the Directory, December 1988 [SC21/WG4]
SC21 N 3317	Working Document on Extended Information Models, December 1988 [SC21/WG4]
SC21 N 3318	Working Document on the Directory Schema, December 1988 [SC21/WG4]
SC21 N 3319	Working Document on Replication and Knowledge Distribution, December 1988 [SC21/WG4]
SC21 N 3320	Working Document on Access Control, December 1988 [SC21/WG4]
SC21 N 3321	Working Document on Enhanced Search, December 1988 [SC21/WG4]
SC21 N 3322	Working Document on Attribute Classes, December 1988 [SC21/WG4]
SC21 N 3323	Request for National Body and CCITT Member Contributions on Directory PICS Proforma, December 1988 [SC21/WG4]
SC21 N 3337	Security Management Domain and Security Policies, December 1988 [SC21/WG4]
SC21 N 3344	IRDS Rapporteur Group Position on Need for IRDS Specialization for RDA, April 1989 [SC21/WG3]
SC21 N 3346	RDA Use of Remote Operation Notation of ROSE, December 1988 [SC21/WG3]
SC21 N 3351	RDA Requirements for CCR, December 1988 [SC21/WG3]
SC21 N 3352	Harmonization of RDA and TP, December 1988 [SC21/WG3]
SC21 N 3365	Guide to ISO Virtual Terminal Standards, February 1989 [SC21/WG5]
SC21 N 3369	Terminal Management (TM) Issues List, February 1989 [SC21/WG5]

SC21 N 3372	Sharing an Association Between FTAM and Other ASE, February 1989 [SC21/WG5]
SC21 N 3381	Statement on TM Strategic Direction, February 1989 [SC21/WG5]
SC21 N 3383	Relationship Between TM and User Interfaces, February 1989 [SC21/WG5]
SC21 N 3674	Information Processing Systems - International Standardized Profiles - Directory of ISPs and Profiles Contained Therein, June 1989
SC21 N 3675	Information Processing Systems - International Standardized Profiles - ISP Approval and Maintenance Process, June 1989
SC21 N 3678	Information Processing Systems - International Standardized Profiles - Proposed New AMH Taxonomy, June 1989
SC21 N 3711	Requirements for Multipeer Data Transmission, July 1989
SC21 N 3733	Access Control for OSI Applications, July 1989
SC21 N 3801	Support Environment for Open Distributed Processing, ECMA, September 1989
SC21 N 3806	Request for New Question on Conceptual Schema Standardization, September 1989
SC21 N 3903	Modelling, Specification, Use, and Role of Conceptual Schemas, October 1989
SC21 N 3906	Final Report to SC21 in Florence on the Reassessment of Project JTC 1.21.9.1 on Multipeer Data Transmission, October 1989
SC21 N 3925	Liaison Statement to JTC1 SC21 from JTC1 SWG-EDI, JTC1 SWG-EDI, 19 October 1989
SC21 N 3930	Liaison Statement from JTC1/SC18 to JTC1/SC21/WG5 on Comments on Terminal Management, SC18/WG4, 19 October 1989
SC21 N 3991	Security Exchange Service Element, CCITT Q19/VII(DAF), November 1989 (CD text in SC21/WG6 expected in 1992)
SC21 N 4012	Extended Application Layer Structure, ANSI Contribution to SC21/WG6, 19 October 1989
SC21 N 4019	ODP: Topics List - November 1989 Version - for the Basic Reference Model of Open Distributed Processing, 8 November 1989
SC21 N 4020	ODP: List of Open and Resolved Issues - November 1989 Version, 11 December 1989
SC21 N 4021	ODP: Document Register and Bibliography - November 1989 Version, 11 December 1989
SC21 N 4022	ODP: Working Document on Topic 4.1 - Structures and Functions, 11 December 1989
SC21 N 4023	ODP: Working Document on Topic 6.1 - Modelling Techniques and Their Use in ODP, 11 December 1989
SC21 N 4024	ODP: Working Document on Topic 6.2 - Formalisms and Specifications, 11 December 1989
SC21 N 4025	ODP: Working Document on Topic 8.1 - Draft Basic Reference Model of Open Distributed Processing, 11 December 1989
SC21 N 4026	ODP: Recommendations of SC21/WG7, Florence, 11 December 1989
SC21 N 4027	ODP: Meeting Minutes of the Florence Working Group Meeting of WG7, 11 December 1989
SC21 N 4028	ODP: SC21/WG7 Convener's Report to SC21 Plenary Meeting 11 December 1989
SC21 N 4029	ODP: Liaison Statement to JTC1/TSG-1 on IAP, 11 December 1989
SC21 N 4030	ODP: Cooperation between SC21/WG7 and CCITT SG VII (Q19/DAF), 11 December 1989
SC21 N 4031	ODP: Session Report on Joint Meeting on FDT, 11 December 1989

SC21 N 4032	ODP: Liaison Statement to JTC1/SWG-EDI on EDI Modelling, 11 December 1989
SC21 N 4033	ODP: Proposal for Future Cooperation Between SC21/WG6 and SC21/WG7 on ULA and ODP, 11 December 1989
SC21 N 4058	State Tables for CMIP, January 1990
SC21 N 4077♦	Fault Management Working Document, SC21/WG4, December 1989
SC21 N 4085♦	Accounting Management Working Document, Third Version, SC21/WG4, November 1989
SC21 N 4091♦	OSI Security Management Working Document, 15 November 1989
SC21 N 4107	Modelling for Communications Aspects of Distributed Applications, January 1990 (new work item; CD text expected June 1991)
SC21 N 4108	Management Information in the Upper Layers, January 1990 (new work item; CD expected June 1991)
SC21 N 4162	Proposal for a NWI for Enhancement of FTAM Services to Satisfy Additional User Requirements, December 1989
SC21 N 4184	Request for National Body Comment on Security Enhancements to FTAM, SC21/WG5, November 1989
SC21 N 4186	Request for Comments on Sub-Transactions, November 1989
SC21 N 4188	Response to SC18/WG4 N 1183, Comments on Terminal Management, and SC18/WG3 and CCITT SG VII(Q27) Liaison Statement on Terminal Management, SC21/WG5, December 1989
SC21 N 4189	Comments on the Integration of X-Windows into the OSI Environment, December 1989
SC21 N 4192	Proposed FTAM Document Type to Support CGM, SC21/WG5, December 1989
SC21 N 4195	Draft WG3 Position on Conceptual Schema Question, February 1990
SC21 N 4199	Liaison Statement to JTC1/SC1 on SC21/WG3 Terminology, contains the Reference Model on Data Management (8 August 1989), February 1990
SC21 N 4199	Liaison Statement to JTC1/SC21 on SC21/WG3 Terminology, SC21/WG3, February 1990
SC21 N 4215	Formal Methods in Conformance Testing (new work item, January 1990)
SC21 N 4231	Revised Working Draft for Architectural Semantics for FDTs, SC21/WG1, April 1990
SC21 N 4240	Working Draft Addendum to ISO 7498 - General Aspects, December 1989
SC21 N 4279	CCR Conformance Test Suite, January 1990 (new work item) (WD text expected June 1992, CD text June 1993)
SC21 N 4280	Proposed New Work Item: Conceptual Data Modeling Facility, SC21/WG3, February 1990
SC21 N 4342	Liaison Statement from SC18 to SC21/WG5 on Conference Application New Study Item Including RODE, January 1990
SC21 N 4347	Progression of Work on Network Layer Management, SC6/WG2, January 1990 [SC21 N 4630]
SC21 N 4354	Topics Proposed for Discussion at the JTC1 Workshop on Distributed Applications, Phoenix, March 1990, U.K. Contribution, January 1990
SC21 N 4383	Development of the Extended Information Model, January 1990
SC21 N 4472	Liaison Statement from JTC1/SC18 to JTC1/SC21 on Changes to ASN.1, SC18/WG3 (title is in error--changes are for ODA, ISO 8613), 22 February 1990
SC21 N 4511	U.S. Comments on Conceptual Schema, ANSI, 15 March 1990

SC21 N 4519	Clarification of ALS Modelling Concepts, Workshop on Distributed Applications, 18 April 1990
SC21 N 4520	Issues for Consideration by Joint ULA/ODP Meeting, Seoul, May/June 1990, Workshop on Distributed Applications, 18 April 1990
SC21 N 4523	Modelling of Application Program Interfaces and Remote Procedure Calls, Distributed Applications Workshop, 2 April 1990
SC21 N 4524	Consideration of the Data Management Component of Application Standards, Workshop of Distributed Applications, 23 April 1990
SC21 N 4526	Application Layer Security Considerations, Workshop of Distributed Applications, 18 April 1990
SC21 N 4546	Liaison Statement of SC21/WG1 on Update of the OSI Reference Model, CCITT SG VII, March 1990
SC21 N 4559	Liaison Statement to SC21 on OSI Reference Model Update Effort, CCITT SG VII, March 1990
SC21 N 4564	ODP: Liaison Statement to SC21/WG7 on Relationship of DAF Architecture/Infrastructure with ODP Topic 4 - Functions and Interfaces, CCITT SG VII, March 1990
SC21 N 4565	Liaison Statement to SC21/WG4/WG7 on Time Synchronization, CCITT SG VII, March 1990
SC21 N 4593	Metadata Use and Standards for Managing Metadata, ANSI, 4 April 1990
SC21 N 4603	Position on Reassessment of JTM Full Class Protocol, AFNOR, March 1990
SC21 N 4623	Extensible Matching Rules (Revised), Canada, 3 May 1990
SC21 N 4641	U.S. Position on JTM Reassessment, March 1990
SC21 N 4647	Requirements for Service Conventions, May 1990
SC21 N 4648	Security and Security Exchange Information, 28 February 1990, Canadian Contribution to SC21/WG6
SC21 N 4655	Architectural Semantics for ODP - Reassessment Report, SC21/WG7, April 1990
SC21 N 4672	Liaison Statement on Character Internationalization, SC21/WG3 on Database Language Extended SQL, 26 May 1990
SC21 N 4674	Liaison Statement Regarding Common Application Interfaces for the Telematic Services, CCITT SG I, 23 May 1990
SC21 N 4679	Reassessment of Project 1.21.13.03 (JTM Full Class), SC21, 10 June 1990
SC21 N 4681	User Requirements for Multi-Party Communications (MPC), Canada, May 1990
SC21 N 4682	Establishment of User Requirements, Canada, May 1990
SC21 N 4709	Directory Implementor's Guide, CCITT WG VII(Q.20), June 1990
SC21 N 4716	Initial List of Planned PDISPs, 30 April 1990
SC21 N 4744	Development of the DSA Information Model: Extended Distribution Knowledge Model, SC21/WG4, May 1990
SC21 N 4758	Request to ISO/IEC SC21 from OSF for Establishment of Liaison Relationship, 4 May 1990
SC21 N 4763	On-Going Multipeer Projects Within JTC1, ANSI, May 1990
SC21 N 4764	Progression of Association Pools, ANSI, 9 May 1990
SC21 N 4766	U.S. Response to SC21/WG6 N 770 on Requirements for Extended ALS, ANSI, May 1990
SC21 N 4767	US Response to SC21/WG6 N 7889 on Requirements for RPC Interface Definition Notation, 11 May 1990

SC21 N 4769	Discussion of Initial Schema Information Acquisition for Directory, SC21/WG4, May 1990
SC21 N 4770	Short-Form Names for Directory, SC21/WG4, May 1990
SC21 N 4771	US Positions on SC21 N 433, Working Draft on the Schema, SC21/WG4, May 1990
SC21 N 4773	Development of the DSA Information Model: Basic Distribution Knowledge, SC21/WG4, May 1990
SC21 N 4799	Letter for Information on Disposition of EDIMS Use of Directory, 21 May 1990
SC21 N 4801	Liaison Statement to SC21 on Joint Efforts Between SG VII(Q20) and SG I(Q16), CCITT SG I(Q.16), 21 May 1990
SC21 N 4802	Liaison Statement to SC21 on Comments on Short Form Names and Other Name Forms, CCITT SG I(Q.16), 21 May 1990
SC21 N 4803	Publication of Directory Schema and Other Registered Object Definitions, Canada, 2 May 1990
SC21 N 4804	Proposed DIT Structure Rule Definition, 10 May 1990
SC21 N 4806	Use of External Data Transfer Systems for Shadow Updates, 10 May 1990
SC21 N 4833	Report to JTC1 from SC27 on Security Techniques, SC27 Secretariat, 21 May 1990 [SC27 N 94, 3 May 1990]
SC21 N 4834	Liaison Statement from SC27 to JTC1 Advisory Group, SC27 Secretariat, 21 May 1990 [SC27 N 93, 3 May 1990]
SC21 N 4835	Report of the First Plenary Meeting of SC27 at Stockholm, 24-26 April 1990, SC27 Secretariat, 21 May 1990 [SC27 N 92, 1 May 1990]
SC21 N 4836	Resolutions Taken at the First Plenary Meeting of SC27 at Stockholm, 24-26 April 1990, 21 May 1990 [SC27 N 94, 3 May 1990]
SC21 N 4871	G-LOTOS: Draft Addendum 1 to IS 8807 on Graphical Representation for LOTOS
SC21 N 4875	Recommendation on SQL2 Progress ISO 9075 Revised, 31 May 1990
SC21 N 4902	Working Draft Answer to Q6/1 on Version and Extensions, SC21/WG6, June 1990
SC21 N 4903	Methodology and Guidelines for the Development of Application Layer Standards, SC21/WG6, June 1990
SC21 N 4904	Request for Comment on Characteristics of an Application Service Element and Application Service Object, SC21/WG6, May 1990
SC21 N 4905	Request for Comment on Introduction of a New Relationship in ALS, SC21/WG6, June 1990
SC21 N 4906	Upper Layer Management - Call for Contributions, SC21/WG6, June 1990
SC21 N 4907	Response to CCITT Liaison on Service Data Unit Sizes in Connectionless-Mode Services, SC21/WG6, June 1990
SC21 N 4908	Liaison to CCITT SG VII(Q19,Q25) on ULA Topics, SC21/WG6, June 1990
SC21 N 4914	Working Document on the Directory Schema, SC21/WG4 and CCITT Collaborative Meeting on Directory, May 1990
SC21 N 4918	Question on Standardization of Directory API, July 1990
SC21 N 4922	Information on Distributed Entries, SC21/WG4, July 1990
SC21 N 4924	Extensions to Directory Abstract Service, Working Draft, SC21/WG4, July 1990
SC21 N 4925	Liaison to SC22/WG11 Concerning Remote Procedure Call Interface Definition Notation (IDN), June 1990
SC21 N 4926	Liaison to CCITT SG VII(Q19) on DAF, SC21/WG6, June 1990
SC21 N 4927	Working Draft, Information Processing Systems - Open Systems Interconnection - Remote Procedure Call, SC21/WG6, 1 June 1990

SC21 N 4928	Remote Procedure Call Definitions and Requirements, SC21/WG6, June 1990
SC21 N 4939	Recommendations of the Seventh SC21/WG4 Meeting, Seoul, 22-31 May 1990, May 1990
SC21 N 4940	SC21/WG4 Convenor's Report to ISO/IEC JTC1/SC21 Plenary Meeting, Seoul, 5-6 June 1990, 5 June 1990
SC21 N 4941	Recommendations of the Seventh SC21/WG4 Meeting, Seoul, 22-31 May 1990, May 1990
SC21 N 4942	Systems Management Tutorial, SC21/WG4, July 1990 (new work item)
SC21 N 4943	Extended Systems Management Architecture, SC21/WG4, July 1990 (new work item; planned to be an amendment to DIS 10040)
SC21 N 4944	Generic Managed Objects, SC21/WG4, July 1990 (new work item)
SC21 N 4945	Definition of a Management Information Register and Registration Procedures, SC21/WG4, July 1990 (new work item)
SC21 N 4946	Requirements and Guidelines for Managed Object Conformance Statement (MOCS) Proformas, SC21/WG4, July 1990 (new work item)
SC21 N 4947	Formal Descriptions of CMIP, SC21/WG4, July 1990 (new work item)
SC21 N 4948	Systems Management Relationship Model, SC21/WG4, July 1990 (new work item; expected to use entity-relationship modelling)
SC21 N 4949	Systems Management: Response Time Monitoring Function, SC21/WG4, July 1990 (new work item)
SC21 N 4951	Test Suites for OSI Directory, SC21/WG4, July 1990 (new work item)
SC21 N 4953	Time Management: Representation of Time, SC21/WG4, July 1990
SC21 N 4960	Generic Managed Objects, Working Draft, SC21/WG4, July 1990
SC21 N 4961	Request for Contributions to Progress Work on the Definition of State Tables for CMIP, May 1990
SC21 N 4968	Synchronization Across Multiple Managed Objects, SC21/WG4, July 1990
SC21 N 4969	Call for National Body Contributions on Time Management, SC21/WG4, May 1990
SC21 N 4973	The Use of System Title by OSI Management, SC21/WG4, July 1990
SC21 N 4974	Use of Global Naming for Identification of Managed Objects, SC21/WG4, July 1990
SC21 N 4975	A General Model for Relationship Management, SC21/WG4, 31 May 1990
SC21 N 4976	Software Management Function, SC21/WG4, July 1990 (CD text expected June 1991)
SC21 N 4977	Use of Action to Invoke State Changes, SC21/WG4, July 1990
SC21 N 4979	Request for National Body Comment on the Need for an Access Control Information Management Function, SC21/WG4, May 1990
SC21 N 4980	Security Audit Framework Working Document, SC21/WG4, July 1990
SC21 N 4981 ♦	Performance Management Working Document, Sixth Working Draft, 4 July 1990
SC21 N 4982	WG4 Systems Management Issues, SC21/WG4, July 1990
SC21 N 4991	Plan for Meetings for SC21/WG4 (Systems Management) for Period June 1990 - September 1991, May 1990
SC21 N 4998	Proposals for the Maintenance and Revision of SC21 Standards, SC21, June 1990
SC21 N 5001	Upper Layers Security Model, Third Working Draft, SC21/WG6, 5 June 1990 (CD text expected in 1991)
SC21 N 5002	Commencement of Work on Security ASEs, SC21/WG6, 31 May 1990
SC21 N 5003	Distributed Applications Security Modelling and Infrastructure, SC21/WG6, July 1991

SC21 N 5011	Modelling Recovery in the Application Layer, SC21/WG6, 1 June 1990 (new work item; CD text expected June 1991)
SC21 N 5014	Liaison Statement to CCITT SG VII (Q.23) on Collaborative Work on OSI Registration, 6 June 1990
SC21 N 5016	Meeting Report for SC21/WG1/WG4/WG6/WG7 Joint Meeting on Service Conventions, ODP, and ULA on 29 May 1990, SC21, June 1990
SC21 N 5017	Relationship Between Concepts and Models for OSI and ODP, SC21/WG6, July 1990
SC21 N 5049	Guide to Open System Security, SC21, July 1990
SC21 N 5051	Working Document on ASN.1 Extensions, Character Sets, Version 3, SC21/WG6, 19 July 1990 supercedes N 4141]
SC21 N 5052	Working Document on ASN.1 Extensions, Table Types and Functions, Version 4, SC21/WG6, 11 July 1990 supercedes N 4143]
SC21 N 5053	Working Document on ASN.1 Extensions, Machine Processibility, Version 3, SC21/WG6, 31 May 1990 supercedes N 4140]
SC21 N 5054	Working Document on Presentation Service to Give Confidentiality and Integrity Protection, SC21/WG6, 11 July 1990
SC21 N 5055	Working Document on ASN.1 Extensions, Miscellaneous Enhancements, Version 3, SC21/WG6, 31 May 1990 supercedes N 4139]
SC21 N 5056	Call for Comment on Computed Functions, SC21/WG6, 11 July 1990
SC21 N 5061	Handling of Exception Cases in ASN.1, SC21/WG6, 11 July 1990
SC21 N 5062	Notes on the Presentation and ASN.1 Meeting, SC21/WG6, 14 June 1990
SC21 N 5063	Liaison on Handling of Character Sets in ASN.1, JTC1/SC2, 14 June 1990
SC21 N 5069	Call for Comments on Technical Approval for Development of ASN.1 Work Plan, SC21/WG6, 11 July 1990
SC21 N 5071	Recommendations Approved by SC21/WG1 at its Seoul Meeting, 23-31 May 1990, SC21/WG1, May 1990
SC21 N 5072	List of Output Documents of SC21/WG1 Meeting, Seoul, 23-31 May 1990, SC21/WG1, July 1990
SC21 N 5073	Final Answer to Q1/30.5 on Definition of the Term "Quality of Service," SC21/WG1, May 1990
SC21 N 5074	Final Answer to Q1/330.6 on Relay, Routing, and Network Management, SC21/WG1, May 1990
SC21 N 5075	Protocol Profile Testing Methodology, Second Working Draft, SC21/WG1, July 1990
SC21 N 5078	Catalogue of PICS Proforma Notations, SC21/WG1, July 1990
SC21 N 5079	Draft Answer to Q1/63.1 on Conformance to Objects in the Context of OSI Management, SC21/WG1, May 1990
SC21 N 5080	Call for Contributions on OSI Management Conformance Issues, SC21/WG1, July 1990
SC21 N 5081	Draft Answer to Q1/61 on Consistency Among ISO Standards Related to the OSI Reference Model, May 1990
SC21 N 5082	Call for Contributions on Protocol Profile Testing Methodology, Multi-Party Testing Methodology, TTCN Extensions, and Test Report Standardization, SC21/WG1, July 1990
SC21 N 5084	Liaison Statement to SC6 on OSI Conformance Issues, SC21/WG1, May 1990
SC21 N 5092	Revision of ISO 7498, Working Draft, SC21/WG1, July 1990

SC21 N 5093	Status and Method of Operation for the Reference Model Revision, SC21/WG1, May 1990
SC21 N 5095	Liaison to SC6 on Revision of the Reference Model, May 1990
SC21 N 5096	Liaison to CCITT SG VII on Revision of the Reference Model, June 1990
SC21 N 5099	Liaison Statement to CCITT SG VII(Q.25) on Service Conventions, SC21/WG1, May 1990
SC21 N 5105	Final Answer to Q1/56.6.1 on Positioning of Circuit Switched Networks, SC21/WG1, May 1990
SC21 N 5107	SC21/WG3 (Database) Convenor's Report to Plenary, May 1990
SC21 N 5109	Liaison Statement to CCITT SG VII(Q23) on Naming and Addressing, SC21/WG1, May 1990
SC21 N 5110	Call to National Bodies and Liaison Organizations for Contributions on Technical Structure of Quality of Service (QoS) Architecture, May 1990
SC21 N 5112	Discussion Paper on Formal Methods in Conformance Testing, SC21/WG1, July 1990
SC21 N 5116	Architectural Semantics for FDTs, Working Draft, SC21/WG1, July 1990
SC21 N 5117	Multi-Party Testing for MHS, SC21/WG1, July 1990
SC21 N 5127	Proposed Schedule for Progression of CCR Amendments and CCR PICS, SC21/WG6, June 1990
SC21 N 5131	Recommendations of the SC21/WG6 Meeting, 23 May - 1 June 1990, Seoul, SC21/WG6, June 1990
SC21 N 5136	Recommendations of SC21/WG3 Meeting in Seoul, May/June 1990, SC21/WG3, 19 June 1990
SC21 N 5137	Data Management Export/Import for SQL and IRDS, SC21/WG3, July 1990 (new work item)
SC21 N 5138	RDA Support for Shared DBL Statements, SC21/WG3, July 1990 (new work item; rapporteur meeting January 1991)
SC21 N 5139	IRDS Extensions, SC21/WG3, July 1990 (new work item)
SC21 N 5140	Proposal for Registration of Q3/001, SC21/WG3, 19 June 1990
SC21 N 5141	Proposal for Registration of Q3/002, SC21/WG3, 19 June 1990
SC21 N 5146	Proposal for Registration of Q3/007, SC21/WG3, 19 June 1990
SC21 N 5154	Recommendations of the SC21/WG5 Meeting, Seoul, 24 May - 1 June 1990, SC21/WG5, June 1990
SC21 N 5155	Enhancement of FTAM Security Services, New Work Item Proposal, SC21/WG5, July 1990
SC21 N 5156	TP Sub-Transactions, New Work Item Proposal, SC21/WG5, July 1990
SC21 N 5157	TP Separate Data and Commit Associations, New Work Item Proposal, SC21/WG5, July 1990
SC21 N 5158	Conformance Test Suite for the VT Protocol, July 1990 (new work item; CD text expected November 1990)
SC21 N 5162	WD xxxx, Information Processing Systems - Open systems Interconnection Interconnection - Conformance Test Suite for the VT Protocol - Test Suite and Test Procedures, June 1990
SC21 N 5164	Planned Work Schedule for FTAM, SC21/WG5, June 1990
SC21 N 5165	FTAM Constraint Set and Document Types for CGM, SC21/WG5, June 1990
SC21 N 5169	Plan for OSI TP DIS Editing, SC21/WG5, June 1990 (editing meetings planned for Nov-Dec 1990, Mar-Apr 1991, and May 1991)

SC21 N 5170	OSI TP Association Management - Statement of Requirements, SC21/WG5, June 1990
SC21 N 5171	OSI TP Security - Statement of Requirements, SC21/WG5, June 1990
SC21 N 5172	Combined Use of RPC and OSI TP, SC21/WG5, June 1990
SC21 N 5173	Working Draft Unstructured Data Transfer (UDT) for TP, SC21/WG5, May 1990
SC21 N 5176	OSI TP Security, New Work Item, June 1990
SC21 N 5177	OSI TP Association Management - Revised New Work Item, SC21/WG5, June 1990
SC21 N 5179	Proposed Replacement Text for the NWI Proposal on Commitment Optimizations in SC21 N 4168 (JTC1 N 631), SC21/WG5, June 1990
SC21 N 5183	Combined Use of CMISE and OSI TP, SC21/WG5, June 1990
SC21 N 5184	Queued Data Transfer for TP, SC21/WG5, May 1990
SC21 N 5189	Liaison Statement to JTC1/SWG-EDI on EDIFACT Document Types for FTAM, SC21/WG5, June 1990
SC21 N 5193	Conceptual Schema HOD/C Meeting report Held on 31 May 1990 in Seoul, July 1990
SC21 N 5194	Resolutions of the Fourth Plenary Meeting of SC21, 5 June 1990, Seoul, SC21, 5 June 1990
SC21 N 5196	Report of the Special Meeting on User Requirements, SC21, 7 June 1990
SC21 N 5197	Report of the Standards Maintenance Group, SC21, 4 June 1990
SC21 N 5203	SC21/WG1 Convenor's Report to SC21 Plenary Meeting, Seoul, 5-6 June 1990, SC21/WG1, 3 June 1990
SC21 N 5205	ISO/IEC JTC1/SC21 WG1 Programme of Work, May 1990
SC21 N 5213	Call for Contributions on Plan for WG4 Systems Management, 5 June 1990
SC21 N 5219	Draft Management Guidelines for SC21, Rapporteur for Strategic Planning, July 1990
SC21 N 5222	Working Document on the Extended Directory Information Models, SC21/WG4 and CCITT Collaborative Meeting on Directory, July 1990
SC21 N 5228	Report of the ISO/IEC JTC1/SC21 Plenary Meeting, 5 June 1990, Seoul, Korea, 30 July 1990
SC21 N 5228	Proposed Technical Corrigenda to ISO 9595 and ISO 9596
SC21 N 5229	Report of the JTC1/SC21 Plenary Meeting, 5 June 1990, Seoul, Republic of Korea
SC21 N 5253	Working Document on Replication and Knowledge Distribution, SC21/WG4 and CCITT Collaborative Meeting on Directory, June 1990
SC24 N 224	PHIGS Plus, 1989

New Work Items Approved by JTC1:

JTC1 N 760	Enhanced Search for Directory, 30 April 1990
JTC1 N 761	State Tables for CMIP - Addendum to ISO 9596, 30 April 1990
JTC1 N 762	Systems Management - Part X: Software Management Function, 30 April 1990
JTC1 N 763	Time Management, 30 April 1990
JTC1 N 764	Extension to 9545, Application Layer Structure, for Application Layer Recovery Model, 30 April 1990
JTC1 N 765	Modelling for Communications Aspects of Distributed Applications, 30 April 1990
JTC1 N 766	Management Information for the OSI Upper Layers, 30 April 1990

JTC1 N 767	Service Definition and Protocol Specification for an "Authentication Exchange ASE," 30 April 1990
JTC1 N 768	Additional Resynchronization Functionality, 30 April 1990
JTC1 N 769	Model, Service, and Protocol for Remote Procedure Call, 30 April 1990
JTC1 N 770	Conformance Test Suite for ISO 9041, Basic Class VT Protocol - Test Suite Structure and Test Purposes, 30 April 1990
JTC1 N 771	Enhancements of FTAM Services to Satisfy Additional User Requirements, 30 April 1990
JTC1 N 772	Transaction Processing Security, 30 April 1990
JTC1 N 773	Transaction Processing Association Management, 30 April 1990
JTC1 N 774	Application Context Proforma for OSI TP, 30 April 1990
JTC1 N 775	Data Transfer for OSI TP, 30 April 1990
JTC1 N 776	Transaction Processing Heuristics Decisions, 30 April 1990
JTC1 N 777	Transaction Processing Commitment Optimizations, 30 April 1990
JTC1 N 778	PICS Proforma for OSI Distributed Transacuon Processing, 30 April 1990
JTC1 N 779	Distributed Transaction Processing - Dialogue Recovery and User Suspension of a Dialogue, 30 April 1990
JTC1 N 805	Conformance Test Suite for the TP Protocol, 30 April 1990
JTC1 N 806	Conformance Test Suite for the CCR Protocol, 30 April 1990
JTC1 N 807	Formal Methods in Conformance Testing of OSI Protocols, 30 April 1990
JTC1 N 846	Extension to ISO 9545 Application Layer Structure for Multi-Level Structures, 18 May 1990
JTC1 N 847	OSI Protocol Profile Testing Methodology, Methods of Testing, 18 May 1990; to become ISO 9646-6
JTC1 N 891	Standard for Ada/SQL Language Interface, 29 June 1990

New Work Items Proposed for JTC1:

JTC1 N 957	Systems Management Tutorial (to result in a Technical Report), 3 August 1990 [SC21 N 4942, 5 June 1990]
JTC1 N 958	Extended Systems Management Architecture (WD 10040-2), 3 August 1990 [SC21 N 4943, 5 June 1990]
JTC1 N 957	Generic Managed Object (GMO) Specification (WD 10165-X), 3 August 1990 [SC21 N 4944, 5 June 1990]
JTC1 N 960	Management Information Register (MIR) and Registration Procedures (two new standards), 3 August 1990 [SC21 N 4945, 5 June 1990]
JTC1 N 961	Requirements and Guidelines for Managed Object Implementation Conformance Statement (MOCS) Proformas (Specification) (addendum to DIS 10165-4), 3 August 1990 [SC21 N 4946, 5 June 1990]
JTC1 N 962	Systems Management Relationship Model (amendment to DIS 10164-3), 3 August 1990 [SC21 N 4948, 5 June 1990]
JTC1 N 963	Systems Management - Response Time Monitoring Function (new part for DIS 10164), 3 August 1990 [SC21 N 4949, 5 June 1990]
JTC1 N 964	Test Suites for OSI Directory (new multi-part standard), 3 August 1990 [SC21 N 4951, 5 June 1990]
SC21 N 4951	Test Suites for OSI Directory, July 1990

II. CCITT RECOMMENDATIONS[3]

A. F-SERIES TELEMATIC SERVICES

CCITT F.200♦[4]	Teletex Service
CCITT F.200♦	Teletex Service, Annex C: Mixed Mode of Operation
CCITT F.201♦	Internetworking Between the Teletex Service and the Telex Service
CCITT F.400	Message Handling System and Service Overview
CCITT F.401	Naming and Addressing for Public Message Handling Services
CCITT F.410	The Public Messaging Transfer Service
CCITT F.415	Intercommunication with Public Physical Delivery Services
CCITT F.420	The Public Interpersonal Messaging (IMP) Service
CCITT F.421	Intercommunication Between the IPM Service and the Telex Service
CCITT F.422	Intercommunication Between the IPM Service and the Teletex Service
CCITT F.500	International Public Directory Services

B. I- SERIES ISDN SERVICES

CCITT I.110	General Structure of the I-Series Recommendations
CCITT I.111	Relationship with Other Recommendations Relevant to ISDNs
CCITT I.112	Vocabulary of Terms for ISDNs
CCITT I.113	Vocabulary of Terms for Broadband Aspects of ISDNs
CCITT I.120	Integrated Service Digital Networks (ISDNs)
CCITT I.121	Broadband Aspects of ISDNs
CCITT I.122	Framework for Providing Additional Packet Mode Bearer Services
CCITT I.130	Attributes for the Characterization of Telecommunications Services Supported by an ISDN and Network Capabilities of an ISDN
CCITT I.140	Attribute Techniques for the Characterization of Telecommunication Services Supported by an ISDN and Network Capabilities of an ISDN
CCITT I.141	ISDN Network Charging Capabilities Attributes
CCITT I.144	Number Identification Supplementary Services
CCITT I.200	Guidance to the I.200 Series of Recommendations

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[3] CCITT Recommendations are final versions of 1988 documents (Blue Book) unless otherwise indicated.

[4] The symbol ♦ is used throughout this Section to identify those recommendations included in the November 1989 (Fifth Edition) *NTIS Transition Strategy* [Ref. 4].

CCITT I.210	Principles of Telecommunications Services Supported by an ISDN
CCITT I.211	Bearer Services Supported by an ISDN
CCITT I.212	Teleservices Supported by an ISDN
CCITT I.220	Common Dynamic Description of Basic Telecommunication Services
CCITT I.221	Common Specific Characteristics of Services
CCITT I.230	Definition of Bearer Service Categories
CCITT I.231	Circuit-Mode Bearer Service Categories
CCITT I.232	Packet Mode Bearer Service Categories
CCITT I.240	Definition of Teleservices
CCITT I.241	Teleservices Supported by an ISDN
CCITT I.250	Definition of Supplementary Services
CCITT I.251	Number Identification Supplementary Services
CCITT I.252	Call Offering Supplementary Services
CCITT I.253	Call Completion Supplementary Services
CCITT I.254	Multiparty Supplementary Services
CCITT I.255	Community of Interest Supplementary Services
CCITT I.256	Changing Supplementary Services
CCITT I.257	Additional Information Transfer Supplementary Services
CCITT I.310	ISDN - Network Functional Principles
CCITT I.320	ISDN Protocol Reference Model
CCITT I.324	ISDN Network Architecture
CCITT I.325	Reference Configurations for ISDN Connection Types
CCITT I.326	Reference Configurations for Relative Network Resource Requirements
CCITT I.330	ISDN Numbering and Addressing Principles
CCITT I.331	Numbering Plan for the ISDN Era
CCITT I.332	Numbering Principles for Interworking Between ISDNs and Dedicated Networks with Different Numbering Plans
CCITT I.333	Terminal Selection in ISDN
CCITT I.334	Principles Relating ISDN Numbers/Subaddresses to the OSI Reference Model Network Layer Addresses
CCITT I.335	ISDN Routing Principles
CCITT I.340	ISDN Connection Types
CCITT I.350	General Aspects of Quality of Service and Network Performance in Digital Networks, Including ISDNs
CCITT I.351	Recommendations in Other Services Including Network Performance Objectives that Apply at T Reference Point of an ISDN
CCITT I.352	Network Performance Objectives for Connection Processing Delays in an ISDN
CCITT I.410	General Aspects and Principles Relating to Recommendations on ISDN User-Network Interfaces
CCITT I.411	ISDN User-Network Interfaces - Reference Configurations
CCITT I.412	ISDN User-Network Interfaces - Interface Structures and Access Capabilities
CCITT I.420	Basic User-Network Interface (ISDN)
CCITT I.421	Primary Rate User-Network Interface (ISDN)

CCITT I.430♦	Basic User-Network Interface - Layer 1 Specification (ISDN)
CCITT I.431♦	Primary Rate User-Network Interface - Layer 1 Specification (ISDN)
CCITT I.440	ISDN User-Network Interface - Data Link Layer General Aspects
CCITT I.441♦	ISDN User-Network Interface - Data Link Layer Specification
CCITT I.450♦	ISDN User-Network Interface - Layer 3 General Aspects (Q.921)
CCITT I.451♦	ISDN User-Network Interface - Layer 3 Specification (Q.931)
CCITT I.452	ISDN User-Network Interface - Layer 3 Specification - Generic Procedures for the Control of the ISDN Supplementary Services
CCITT I 460♦	Multiplexing, Rate Adaptation and Support of Existing Interfaces (ISDN)
CCITT I.461♦	Support of X.21 and X.21 bis Based DTEs by an ISDN (X.30)
CCITT I.462♦	Support of Packet Mode Terminal Equipment by an ISDN (X.31)
CCITT I.463♦	Support of DTEs with V-Series Type Interfaces by an ISDN
CCITT I.464♦	Multiplexing Rate Adaptation and Support of Existing Interfaces for Restricted 64 kbit/s Transfer Capability
CCITT I.500	General Structure of the ISDN Interworking Recommendations
CCITT I.510	Definitions and General Principles for ISDN Interworking
CCITT I.511	ISDN to ISDN Layer 1 Internetwork Interface
CCITT I.515	Parameter Exchange for ISDN Interworking
CCITT I.520	General Arrangement for Network Interworking Between ISDNs
CCITT I.530	Network Interworking Between an ISDN and a Public Switched Telephone Network (PSTN)
CCITT I.540	General Arrangement for Network Interworking Between Circuit Switched Public Data Networks (CSPDNs) and ISDNs for the Provision of Data Transmission Services
CCITT I.550	General Arrangement for Network Interworking Between Packet Switched Public Data Networks (PSPDNs) and ISDNs for the Provision of Data Transmission Services
CCITT I.560	Requirements to be Met in Providing the Telex Service Within the ISDN
CCITT I.601	General Maintenance Principles of ISDN Subscriber Access and Subscriber Installation
CCITT I.602	Application of Maintenance Principles to ISDN Subscriber Installation
CCITT I.603	Application of Maintenance Principles to ISDN Basic Accesses
CCITT I.604	Application of Maintenance Principles to ISDN Primary Rate Accesses
CCITT I.605	Application of Maintenance Principles to Static Multiplexed ISDN Basic Accesses

C. T-SERIES TELEMATIC SERVICES

CCITT T.0	Classification of Facsimile Apparatus for Document Transmission Over the Public Networks
CCITT T.5♦	General Aspects of Group 4 Facsimile Apparatus
CCITT T.6♦	Facsimile Coding Schemes and Coding Control Functions for Group 4 Facsimile Apparatus
CCITT T.50	International Alphabet No. 5

CCITT T.51♦	Coded Character Sets for Telematic Services
CCITT T.60♦	Terminal Equipment for Use in the Teletex Service
CCITT T.61♦	Character Repertoire and Coded Character Sets for the International Teletex Service
CCITT T.62♦	Control Procedures for Teletex and Group 4 Facsimile Services
CCITT T.62 bis	Control Procedures for Teletex and Group 4 Facsimile Services Based on Recommendations X.215/X.225
CCITT T.63♦	Provision for Verification of Teletex Terminal Compliance
CCITT T.70♦	Network-Independent Basic Transport Service for the Telematic Services
CCITT T.71♦	LAPB Extended for Half-Duplex Physical Level Facility
CCITT T.72♦	Terminal Capabilities for Mixed Mode of Operation
CCITT T.73♦	Document Interchange Protocol for the Telematic Services
CCITT T.90♦	Teletex Requirements for Internetworking with the Telex Service
CCITT T.91♦	Teletex Requirements for Real-Time Internetworking with the Telex Service in a Packet-Switching Network Environment
CCITT T.330♦	Telematic Access to Interpersonal Messaging System
CCITT T.400	Introduction to Document Architecture, Transfer and Manipulation
CCITT T.411	Open Document Architecture (ODA) and Interchange Format - Introduction and General Principles (see ISO 8613-1)
CCITT T.412	Open Document Architecture (ODA) and Interchange Format - Document Structures (see ISO 8613-2)
CCITT T.414	Open Document Architecture (ODA) and Interchange Format - Document Profile (see ISO 8613-4)
CCITT T.415	Open Document Architecture (ODA) and Interchange Format - Open Document Interchange Format (ODIF) (see ISO 8613-5)
CCITT T.416	Open Document Architecture (ODA) and Interchange Format - Character Content Architectures (see ISO 8613-6)
CCITT T.417	Open Document Architecture (ODA) and Interchange Format - Raster Graphics Content Architectures (see ISO 8613-7)
CCITT T.418	Open Document Architecture (ODA) and Interchange Format - Geometric Graphics Content Architectures (see ISO 8613-8)
CCITT T.419	Document Transfer and Manipulation (DTAM) - Composite Graphics Content Architectures
CCITT T.431	Document Transfer and Manipulation (DTAM) - Services and Protocols, Introduction and General Principles
CCITT T.432	Document Transfer and Manipulation (DTAM) - Services and Protocols, Service Definition
CCITT T.433	Document Transfer and Manipulation (DTAM) - Services and Protocols, Protocol Specification
CCITT T.441	Document Transfer and Manipulation (DTAM) - Operational Structure
CCITT T.501	Document Application Profile MM for the Interchange of Formatted Mixed Mode Documents (Mixed Mode)
CCITT T.502	Document Application Profile PM1 for the Interchange of Processible Form Documents (Teletex Processible Mode)

CCITT T.503	A Document Application Profile for the Interchange of Group 4 Facsimile Documents
CCITT T.504	Document Application Profile for Videotex Interworking
CCITT T.521	Communication Application Profile BTO for Document Bulk Transfer Based on the Session Service (According to Rules Defined in T.62 bis)
CCITT T.522	Communication Application Profile BT1 for Document Bulk Transfer
CCITT T.523	Communication Application Profile DM-1 for Videotex Interworking
CCITT T.541	Operational Application Profile for Videotex Interworking
CCITT T.561	Terminal Characteristics for Mixed Mode of Operation MM
CCITT T.562	Terminal Characteristics for Teletex Processing Mode PM1
CCITT T.563	Terminal Characteristics for Group 4 Facsimile Apparatus
CCITT T.564	Gateway Characteristics for Videotex Interworking

D. V-SERIES

CCITT V.5	Standardization of Data Signalling Rates for Synchronous Data Transmission in the General Switched Telephone Network
CCITT V.6	Standardization of Data Signalling Rates for Synchronous Data Transmission on Leased Telephone-Type Circuits
CCITT V.10/X.26♦	Electrical Characteristics for Unbalanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communication
CCITT V.11/X.27♦	Electrical Characteristics for Balanced Double-Current Interchange Circuits for General Use with Integrated Circuit Equipment in the Field of Data Communications
CCITT V.20♦	Telex and Gentex Signalling on Radio Channels (Synchronous 7-Unit Systems Affording Error Correction by Automatic Repetition)
CCITT V.24♦	List of Definitions for Interchange Circuits Between DTE and DCE
CCITT V.25♦	Automatic Answering Equipment and/or Parallel Automatic Calling Equipment on the General Switched Telephone Network Including Procedures for Disabling of Echo Control Devices for Both Manually and Automatically Established Calls
CCITT V.25 bis♦	Automatic Calling and/or Answering Equipment on the General Switched Telephone Network (GSTN) Using the 100-Series Interchange Circuits
CCITT V.28♦	Electrical Characteristics for Unbalanced Double-Current Interchange Circuits
CCITT V.31♦	Electrical Characteristics for Single-Current Interchange Circuits Controlled by Contact Closure
CCITT V.31 bis♦	Electrical Characteristics for Single-Current Interchange Circuits Using Opto Couplers
CCITT V.35♦	Data Transmission at 48 Kilobits per Second Using 60-108 kHz Group Band Circuits
CCITT V.36♦	Modems for Synchronous Data Transmission Using 60-108 kHz Group Band Circuits
CCITT V.37♦	Synchronous Data Transmission at a Data Signalling Rate Higher than 72 kbit/s Using 60-108 kHz Group Band Circuits
CCITT V.54	Loop Test Devices for Modems

E. X-SERIES PUBLIC DATA NETWORKS

CCITT X.1	International User Classes of Service in Public Data Networks and Integrated Services Digital Networks (ISDNs)
CCITT X.3♦	Packet Assembly/Disassembly Facility (PAD) in a Public Data Network (PDN).
CCITT X.4	General Structure of Signals of International Alphabet No. 5 Code for Data Transmission Over Public Data Networks
CCITT X.10	Categories of Access for DTE to Public Data Transmission Services Provided by PDNs and/or ISDNs through Terminal Adaptors
CCITT X.20♦	Interface Between DTE and DCE for Start-Stop Transmission Services on Public Data Networks
CCITT X.20 bis	Use on Public Data Networks of DTE Which Is Designed for Interfacing to Asynchronous Duplex V-Series Modems
CCITT X.21♦	Interface Between DTE and DCE for Synchronous Operation on Public Data Networks
CCITT X.21 bis♦	Use on Public Data Networks of DTE Which Is Designed for Interfacing to Synchronous V-Series Modems
CCITT X.22♦	Multiplex DTE/DCE Interface for User Classes 3-6
CCITT X.24♦	List of Definitions for Interchange Circuits Between DTE and DCE on Public Data Networks
CCITT X.25-84♦	Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit, 1984
CCITT X.25-88	Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit, 1988
CCITT X.28♦	DTE/DCE Interface for a Start/Stop Mode DTE Accessing the PAD in a PDN Situated in the Same Directory (Country)
CCITT X.29♦	Procedures for the Exchange of Control Information and User Data Between a PAD and a Packet Mode DTE or Another PAD
CCITT X.31♦	Support of Packet Mode Terminal Equipment by an ISDN
CCITT X.32♦	Interface Between DTE and DCE for Terminals Operating in the Packet Mode and Accessing a Packet Switched PDN Through a Public Switched Telephone Network or a Circuit Switched PDN
CCITT X.75-84♦	Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits Between PSDNs
CCITT X.75-88	Terminal and Transit Call Control Procedures and Data Transfer System on International Circuits Between PSDNs
CCITT X.110	International Routing Principles and Routing Plan for Public Data Networks
CCITT X.141	General Principles for the Detection and Correction of Errors in Public Data Networks
CCITT X.150	Principles of Maintenance Testing for Public Data Networks Using DTE and DCE Test Loops
CCITT X.200	Reference Model of OSI for CCITT Applications (see ISO 7498)
CCITT X.208	Specification of Abstract Syntax Notation One (ASN.1) (see ISO 8824, Revised Edition)

CCITT X.209	Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1) (see ISO 8825, Revised Edition)
CCITT X.210	OSI Layer Service Definition Conventions (see ISO TR 8509)
CCITT X.211	Physical Service Definition for OSI for CCITT Applications (see DIS 10022)
CCITT X.212	Data Link Service Definition for OSI for CCITT Applications (see ISO 8886)
CCITT X.213	Network Service Definition for OSI for CCITT Applications (see ISO 8348, 8348/AD2, and 8348/AD3)
CCITT X.214	Transport Service Definition for OSI for CCITT Applications (see ISO 8072, 1986)
CCITT X.215	Session Service Definition for OSI for CCITT Applications (see ISO 8826 and 8326/AD2)
CCITT X.216	Presentation Service Definition for OSI for CCITT Applications (see ISO 8822)
CCITT X.217	Association Control Service Definition for OSI for CCITT Applications (see ISO 8649)
CCITT X.218	Reliable Transfer: Model and Service Definition (see ISO 9066-1)
CCITT X.219	Remote Operations: Model, Notation and Service Definition (see ISO 9072-1)
CCITT X.220	Use of X.200 Series Protocols in CCITT Modifications
CCITT X.223	Use of X.25 to Provide the OSI Connection-Mode Network Service for CCITT Applications (see ISO 8878, 1987)
CCITT X.224	Transport Protocol Specification for OSI for CCITT Applications (see ISO 8073)
CCITT X.225	Session Protocol Specification for OSI for CCITT Application (see ISO 8327 and 8327/AD2)
CCITT X.226	Presentation Protocol Specification for OSI for CCITT Application (see ISO 8823)
CCITT X.227	Association Control Protocol Specification for OSI for CCITT Applications (see ISO 8650)
CCITT X.228	Reliable Transfer: Protocol Specification (see ISO 9066-2)
CCITT X.229	Remote Operations: Protocol Specification (see ISO 9072-2)
CCITT X.244	Procedure for the Exchange of Protocol Identification During Virtual Call Establishment on Packet Switched Public Data Networks
CCITT X.250	Formal Description Techniques for Data Communications Protocols and Services
CCITT X.290	OSI Conformance Testing Methodology and Framework for Protocol Recommendations for CCITT Applications (see DIS 9646-1 and DIS 9646-2)
CCITT X.300	General Principles and Arrangements for Interworking Between Public Data Networks, and Between PDNs and Other Public Networks
CCITT X.301	Description of the General Arrangement for Call Control Within a Subnetwork and Between Subnetworks for the Provision of Data Transmission
CCITT X.302	Description of the General Arrangement for Internal Network Utilities Within a Subnetwork and Immediate Utilities Between Subnetworks for the Provision of Data Transmission Services
CCITT X.305	Functionalities of Subnetworks Relating to the Support of the OSI Connection-Mode Network Service
CCITT X.310	Procedures and Arrangements for DTE Accessing Circuit Switched Digital Data Services Through Analogue Telephone Networks
CCITT X.320	General Arrangements for Interworking Between ISDNs for the Provision of Data Transmission Services
CCITT X.321	General Arrangements for Interworking Between Circuit Switched Public Data Networks (CSPDNs) and ISDNs for the Provision of Data Transmission Services

CCITT X.322	General Arrangements for Interworking Between Packet Switched Public Data Networks (PSPDNs) and CSPDNs for the Provision of Data Transmission Services
CCITT X.323	General Arrangements for Interworking Between PSPDNs
CCITT X.324	General Arrangements for Interworking Between PSPDNs and Public Mobile Systems for the Provision of Data Transmission Services
CCITT X.325	General Arrangements for Interworking Between PSPDNs and ISDNs for the Provision of Data Transmission Services
CCITT X.326	General Arrangements for Interworking Between PSPDNs and Common Channel Signalling Network (CCSN)
CCITT X.327	General Arrangements for Interworking Between PSPDNs and Private Data Networks for the Provision of Data Transmission Services
CCITT X.353	Routing Principles for Interconnecting the Maritime Satellite Data Transmission System with Public Data Networks
CCITT X.400♦	Message Handling Systems (MHSs): System Model - Service Elements (see ISO 10021-1, MOTIS)
CCITT X.401♦	MHSs - Basic Service Elements and Optional User Facilities
CCITT X.402♦	MHSs - Overall Architecture (ISO 10021-2, MOTIS)
CCITT X.403♦	MHSs - Conformance Testing
CCITT X.407♦	MHSs - Abstract Service Definition Conventions (ISO 10021-3, MOTIS)
CCITT X.408♦	MHSs - Encoded Information-Type Conversion Rules
CCITT X.409♦	MHSs - Presentation Transfer Syntax and Notation [replaced by X.208 (ISO 8824 with DAD1) and X.208 (ISO 8825 with DAD1)]
CCITT X.410♦	MHSs - Remote Operations and Reliable Transfer Server [replaced by X.218 (ISO 9066-1), X.219 (ISO 9072-1), X.228 (ISO 9066-2), and X.229 (ISO 9072-2)]
CCITT X.411♦	MHSs - Message Transfer Layer (see ISO 10021-4, MOTIS)
CCITT X.413♦	MHSs - Message Store: Abstract Service Definition (ISO 10021-5, MOTIS)
CCITT X.419♦	MHSs - Protocol Specifications (ISO 10021-6, MOTIS)
CCITT X.420♦	MHSs - Interpersonal Messaging User Agent Layer (ISO 10021-7, MOTIS)
CCITT X.430♦	MHSs - Access Protocol for Teletex Terminals
CCITT X.500	The Directory - Overview of Concepts, Models, and Service (see ISO 9594-1)
CCITT X.501	The Directory - Models (see ISO 9594-2)
CCITT X.509	The Directory - Authentication Framework (see ISO 9594-8)
CCITT X.511	The Directory - Abstract Service Definition (see ISO 9594-3)
CCITT X.518	The Directory - Procedures for Distributed Operation (see ISO 9594-4)
CCITT X.519	The Directory - Protocol Specifications (see ISO 9594-5)
CCITT X.520	The Directory - Selected Attribute Types (see ISO 9594-6)
CCITT X.521	The Directory - Selected Object Classes (see ISO 9594-7)

F. Z-SERIES

CCITT Z.100	Specification and Description Language (SDL)
CCITT Z.110	Criteria for the Use and Applicability of Formal Description Techniques

CCITT Z.200	CCITT High Level Language (CHILL) [see DIS 9496.2]
CCITT Z.301	Introduction to the CCITT Man-Machine Language (MML)
CCITT Z.302	The Meta-Language for Describing MML Syntax and Dialogue Procedures
CCITT Z.311	Introduction to Syntax and Dialogue Procedures (MML)
CCITT Z.312	Basic Format Layout (MML)
CCITT Z.314	The Character Set and Basic Elements (MML)
CCITT Z.315	Input (Command) Language Syntax Specification (MML)
CCITT Z.316	Output Language Syntax Specification (MML)
CCITT Z.317	Man-Machine Dialogue Procedures (MML)
CCITT Z.321	Introduction to the Extended MML for Visual Display Terminals
CCITT Z.322	Capabilities of Visual Display Terminals (VDTs)
CCITT Z.323	Man-Machine Interaction
CCITT Z.331	Introduction to the Specification of the Man-Machine Interface
CCITT Z.332	Methodology for the Specification of the Man-Machine Interface - General Working Procedures
CCITT Z.333	Methodology for the Specification of the Man-Machine Interface - Tools and Methods
CCITT Z.341	Glossary of Terms (MML)

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APPENDIX F

ORGANIZATIONS FOR STANDARDIZATION

ORGANIZATIONS FOR STANDARDIZATION

1. INTRODUCTION

(U) This appendix provides an overview of NATO organizations and other bodies with responsibility for standardization in the fields of communications and information systems. Eventually, this appendix is intended to be expanded to show specific responsibilities of each of the standards bodies. Where appropriate, the charts show the class of STANAGs or other standards maintained by each organization. The emphasis in this appendix is on technical standards for data communications.

2. NATO STANDARDS BODIES

(U) Figure F-1 (foldout) identifies the NATO bodies with responsibility for standardization in communications and information systems. The chart only shows the NATO bodies for which staff support is provided by the NATO Headquarter's staffs, with the exception of those associated with the NATO Communications and Information Systems Organization (NACISO). Operational requirements are the responsibility of the Military Committee, primarily through the Military Agency for Standardization (MAS). Procedural standards are the responsibility of the Allied Data Systems Interoperability Agency (ADSIA), which reports to the Military Committee through the NACISO. Technical standards are the responsibility of the Tri-Service Group on Communications and Electronic Equipment (TSGCEE).

2.1 NATO Technical Standards Bodies

(U) TSGCEE has created a number of subgroups (SGs) and Project Groups (PGs) to develop and maintain technical standards for NATO. The subgroups and selected working groups (WGs) are:[1]

- SG1 on Tactical Area Communications; seeks cooperation among the NATO nations in the development and procurement of tactical area communications for national forces
- SG2 on Tactical Communications Equipment; seeks standardization and interoperability of single-channel communications, excluding those covered by SG1 and SG8
  - WG2 on Narrowband Speech
  - WG3 on Secure Submarine/Air/Surface Communications
  - WG4 on Tactical Communications Equipment for Use in the Air Environment
  - WG5 on Interoperability Standards for Electronic Counter-Countermeasures (ECCM); seeks ECCM interoperability for tactical single-channel radios in the HF, VHF, and UHF bands
  - WG8 on Short-Range Low-Probability-of-Intercept Communications
- SG4 on Navigation and Position Finding
- SG5 on Identification; seeks to enhance the interoperability of current identification equipment and to ensure the standardization, where necessary, to the NATO Identification System (NIS)

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1 (U) *NATO Bodies in the Fields of Communications and Information Systems*, AC/317-D/23, NACISC, April 1988, NATO UNCLASSIFIED; and USMCEB *Directory--US Participants in the International C3 Fora*, Military Communications Electronics Board, Joint Staff, March 1989, UNCLASSIFIED.

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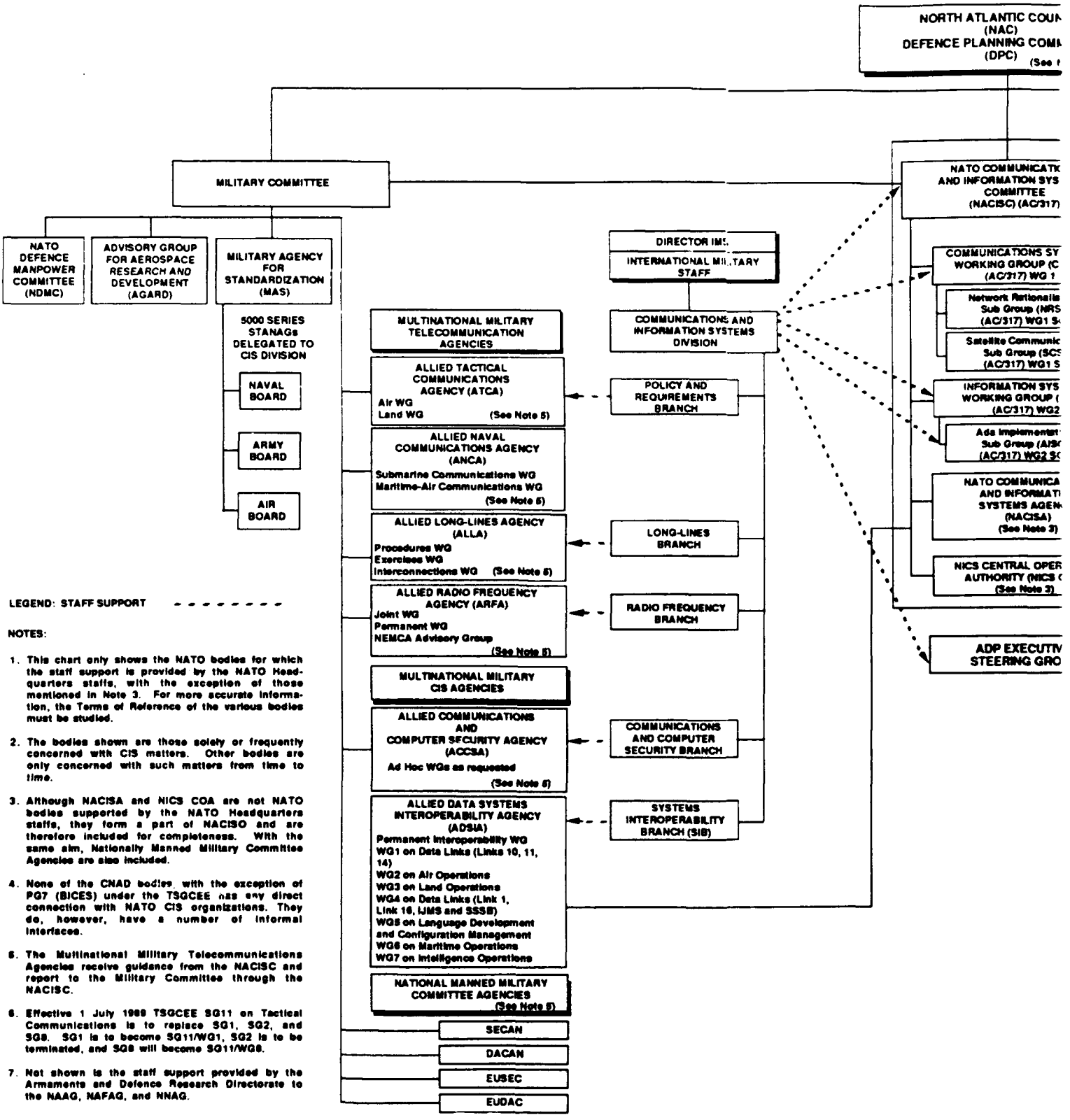


LEGEND: STAFF SUPPORT - - - - - - - -

NOTES:

1. This chart only shows the NATO bodies for which the staff support is provided by the NATO Headquarters staffs, with the exception of those mentioned in Note 3. For more accurate information, the Terms of Reference of the various bodies must be studied.

2. The bodies shown are those solely or frequently concerned with CIS matters. Other bodies are only concerned with such matters from time to time.

3. Although NACISA and NICS COA are not NATO bodies supported by the NATO Headquarters staffs, they form a part of NACISO and are therefore included for completeness. With the same aim, Nationally Manned Military Committee Agencies are also included.

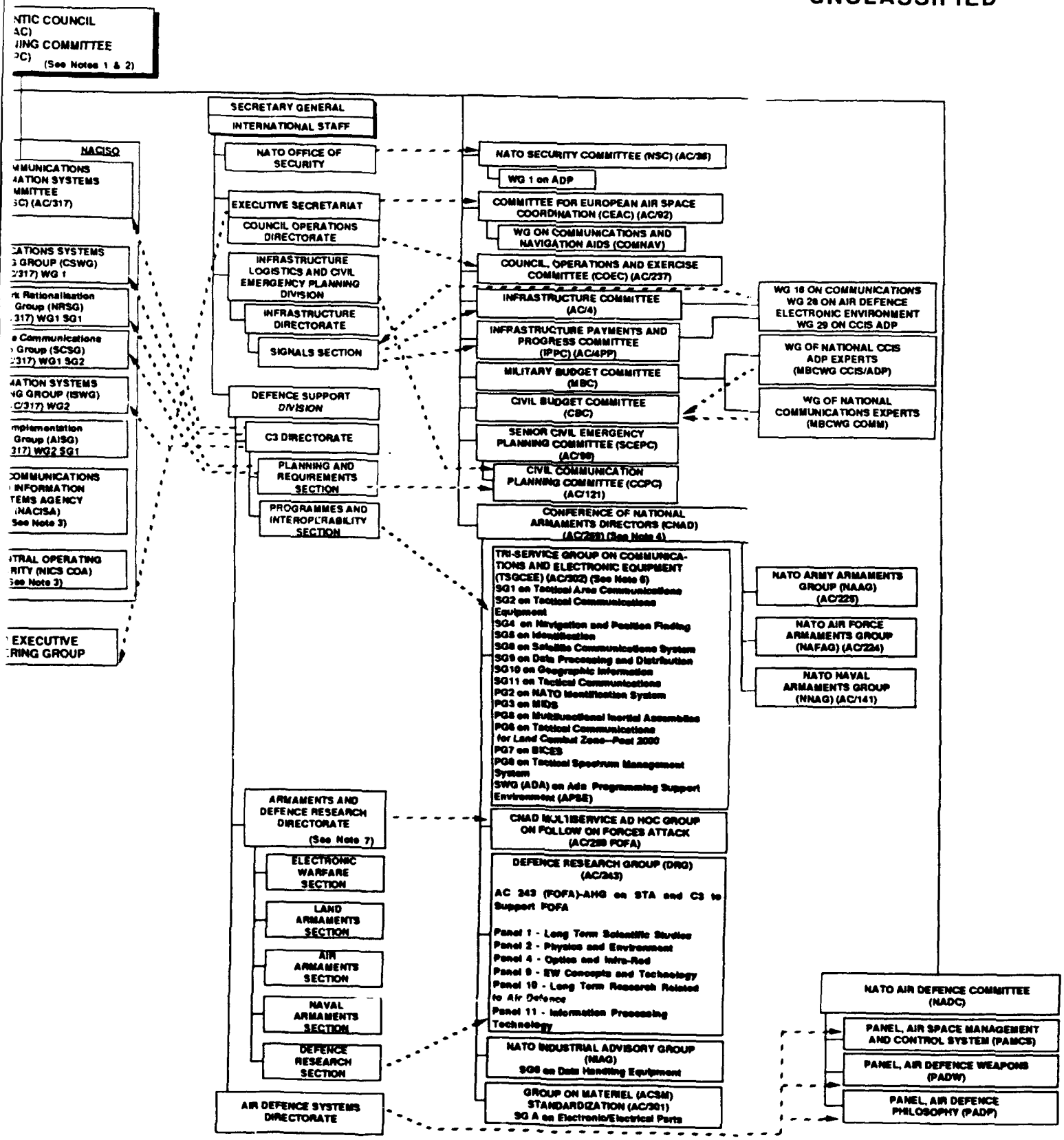
4. None of the CNAD bodies, with the exception of PG7 (BICES) under the TSGCEE has any direct connection with NATO CIS organizations. They do, however, have a number of informal interfaces.

5. The Multinational Military Telecommunications Agencies receive guidance from the NACISC and report to the Military Committee through the NACISC.

6. Effective 1 July 1989 TSGCEE SG11 on Tactical Communications is to replace SG1, SG2, and SG8. SG1 is to become SG11/WG1, SG2 is to be terminated, and SG8 will become SG11/WG8.

7. Not shown is the staff support provided by the Armaments and Defence Research Directorate to the NAAG, NAFAG, and NNAG.

Source: AC/317-D/23, NACISC, April 1988, NATO UNCLASSIFIED.


NTIC COUNCIL
AC)
ING COMMITTEE
C)
(See Notes 1 & 2)
SECRETARY GENERAL
INTERNATIONAL STAFF
NACISO
MMUNICATIONS
ATION SYSTEMS
MMITTEE
C) (AC/317)
ATIONS SYSTEMS
GROUP (CSWG)
/317) WG 1
Rationalisation
Group (NRSG)
317) WG1 SG1
Communications
Group (SCSG)
/317) WG1 SG2
ATION SYSTEMS
G GROUP (ISWG)
C/317) WG2
mplementation
Group (AISG)
317) WG2 SG1
OMMUNICATIONS
INFORMATION
TEMS AGENCY
(NACISA)
See Note 3)
TRAL OPERATING
RITY (NICS COA)
See Note 3)
EXECUTIVE
RING GROUP
NATO OFFICE OF SECURITY
EXECUTIVE SECRETARIAT
COUNCIL OPERATIONS DIRECTORATE
INFRASTRUCTURE LOGISTICS AND CIVIL EMERGENCY PLANNING DIVISION
INFRASTRUCTURE DIRECTORATE
SIGNALS SECTION
DEFENCE SUPPORT DIVISION
C3 DIRECTORATE
PLANNING AND REQUIREMENTS SECTION
PROGRAMMES AND INTEROPERABILITY SECTION
ARMAMENTS AND DEFENCE RESEARCH DIRECTORATE
(See Note 7)
ELECTRONIC WARFARE SECTION
LAND ARMAMENTS SECTION
AIR ARMAMENTS SECTION
NAVAL ARMAMENTS SECTION
DEFENCE RESEARCH SECTION
AIR DEFENCE SYSTEMS DIRECTORATE
NATO SECURITY COMMITTEE (NSC) (AC/35)
WG 1 on ADP
COMMITTEE FOR EUROPEAN AIR SPACE COORDINATION (CEAC) (AC/92)
WG ON COMMUNICATIONS AND NAVIGATION AIDS (COMNAV)
COUNCIL, OPERATIONS AND EXERCISE COMMITTEE (COEC) (AC/237)
INFRASTRUCTURE COMMITTEE (AC/4)
INFRASTRUCTURE PAYMENTS AND PROGRESS COMMITTEE (IPPC) (AC/4PP)
MILITARY BUDGET COMMITTEE (MBC)
CIVIL BUDGET COMMITTEE (CBC)
SENIOR CIVIL EMERGENCY PLANNING COMMITTEE (SCEPC) (AC/98)
CIVIL COMMUNICATION PLANNING COMMITTEE (CCPC) (AC/121)
CONFERENCE OF NATIONAL ARMAMENTS DIRECTORS (CNAD) (AC/280) (See Note 4)
TRI-SERVICE GROUP ON COMMUNICATIONS AND ELECTRONIC EQUIPMENT (TSGCEE) (AC/302) (See Note 6)
SG1 on Tactical Area Communications
SG2 on Tactical Communications Equipment
SG4 on Navigation and Position Finding
SG5 on Identification
SG6 on Satellite Communications System
SG9 on Data Processing and Distribution
SG10 on Geographic Information
SG11 on Tactical Communications
PG2 on NATO Identification System
PG3 on MIDS
PG5 on Multifunctional Inertial Assemblies
PG6 on Tactical Communications for Land Combat Zone—Post 2000
PG7 on BICES
PG8 on Tactical Spectrum Management System
SWG (ADA) on Ada Programming Support Environment (APSE)
CNAD MULTISERVICE AD HOC GROUP ON FOLLOW ON FORCES ATTACK (AC/259 FOFA)
DEFENCE RESEARCH GROUP (DRG) (AC/243)
AC 243 (FOFA)-AHG on STA and C3 to Support FOFA
Panel 1 - Long Term Scientific Studies
Panel 2 - Physics and Environment
Panel 4 - Optics and Infra-Red
Panel 9 - EW Concepts and Technology
Panel 10 - Long Term Research Related to Air Defence
Panel 11 - Information Processing Technology
NATO INDUSTRIAL ADVISORY GROUP (NIAG)
SG6 on Data Handling Equipment
GROUP ON MATERIEL (ACSM) STANDARDIZATION (AC/301)
SG A on Electronic/Electrical Parts
WG 18 ON COMMUNICATIONS
WG 28 ON AIR DEFENCE ELECTRONIC ENVIRONMENT
WG 29 ON CCIS ADP
WG OF NATIONAL CCIS ADP EXPERTS (MBCWG CCIS/ADP)
WG OF NATIONAL COMMUNICATIONS EXPERTS (MBCWG COMM)
NATO ARMY ARMAMENTS GROUP (NAAG) (AC/225)
NATO AIR FORCE ARMAMENTS GROUP (NAFAG) (AC/224)
NATO NAVAL ARMAMENTS GROUP (NNAG) (AC/141)
NATO AIR DEFENCE COMMITTEE (NADC)
PANEL, AIR SPACE MANAGEMENT AND CONTROL SYSTEM (PAMCS)
PANEL, AIR DEFENCE WEAPONS (PADW)
PANEL, AIR DEFENCE PHILOSOPHY (PADP)

  - WG4 on Question and Answer (Q&A) System Interoperability; dedicated to Mark X/Mark XII issues, but will consider issues affecting the optimum implementation of the NATO Q&A
  - WG5 on Transition to the NIS Q&A
  - WG6 on Data Processing
- SG8 on Satellite Communications (SATCOM) Systems; seeks SATCOM interoperability between NATO and national military SATCOM systems
- SG9 on Data Processing and Distribution; focuses on the development of data communications protocols, specifically for the NATO OSI Reference Model
  - WG1 on OSI Layers 1-4--standards and functional profiles
  - WG2 on OSI Layer 5-7--standards and functional profiles
  - WG3 on Communications System/Network Interoperability (CSNI)
  - Ad Hoc Working Group (AHWG) on Security
  - AHWG on Integrated Services Digital Network (ISDN)
  - AHWG on OSI Management
- SG10 on Geographic Information
- SG11 on Tactical Communications (newly formed).

Effective 1 July 1989, TSGCEE SG11 replaced SG1, SG2, and SG8. SG1 became WG1 of SG11, SG2 was terminated, and SG8 became WG8 of SG11.

(U) The Project Groups of SG9 are:

- PG2 on NATO Identification System (not currently active; see SG5)
- PG3 on Multinational Information Distribution System (MIDS)
  - WG1 on the MIDS STANAG 4175
  - WG2 on the MIDS Terminal Development
- PG5 on Multifunctional Inertial Sensor Assemblies
- PG6 on Tactical Communications Systems for the Land Combat Zone--Post 2000; seeks, through a coordinated program, tactical communications systems designed to common standards
- PG7 on Battlefield Information and Exploitation Systems (BICES); WG1 is working on a NATO ESM System
- PG8 on a Tactical Spectrum Management System, planned to support management of radio frequencies in the combat zone.

Liaison among these bodies (e.g., PG6 and SG9) is normally at the Secretary level. Plans are coordinated in annual meetings of the Secretaries and Action Officers of the Allied Tactical Communications Agency (ATCA), the Allied Naval Communications Agency (ANCA), the Allied Communications and Computer Security Agency (ACCSA), and the communications subordinate groups of TSGCEE.[2]

(U) To a limited degree, technical standards are also being addressed in the NATO Industrial Advisory Group (NIAG), specifically in SG6 on Compatibility of Naval Data Handling Equipment. NIAG SG6 is making recommendations on standards to be used in shipboard combat systems for data distribution, such as the Network Independent Interface (NIIF).

(U) Table F-1 and Figure F-2 highlight the relationships among the NATO standards bodies whose responsibilities be discussed in a chart that follows. To clarify the relationships among the organizations and to emphasize those bodies concerned with technical standards, some of the NATO bodies

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2 (U) "Working Relationships," Note by the Secretary, AC/317-N/185, NACISC, 24 February 1989, NATO UNCLASSIFIED.

Table F-1. (U) Acronyms and Titles of Key NATO Bodies in the Fields of Communications and Information Systems

UNCLASSIFIED

Acronym	Name
NAC	North Atlantic Council
DPC	Defence Planning Committee
MC	Military Committee
AGARD	Advisory Group for Aerospace Research and Development
MAS	Military Agency for Standardization
MNCs	Major NATO Commands
ACE	Allied Command Europe
CHAN	Allied Channel Command
LANT	Allied Command Atlantic
ATCA	Allied Tactical Communications Agency
ANCA	Allied Naval Communications Agency
ALLA	Allied Long Lines Agency
ARFA	Allied Radio Frequency Agency
ACCSA	Allied Communications and Computer Security Agency
ADSIA	Allied Data Systems Interoperability Agency
SECAN	Communications Security and Evaluation Agency
DACAN	Distribution and Accounting Agency
EUSEC	European Security and Evaluation Committee
EUDAC	European Distribution and Accounting Agency
IMS	International Military Staff
CIS DIV	Communications and Information Systems Division
NACISO	NATO Communications and Information Systems Organization
NACISC	NATO Communications and Information Systems Committee
CSWG	Communications Systems Working Group
NRSG	NATO Rationalization Subgroup
SCSG	Satellite Communications Subgroup
ISWG	Information Systems Working Group
AISG	Ada Implementation Subgroup
NACISA	NATO Communications and Information Systems Agency
NICS-COA	Central Operating Authority
CNAD	Conference of NATO Armaments Directors
TSGCEE	Tri-Service Group on Communications and Electronic Equipment
NAAG	NATO Army Armaments Group
NAFAG	NATO Air Force Armaments Group
NNAG	NATO Navy Armaments Group
DRG	Defence Research Group
NIAG	NATO Industrial Advisory Group
CEAC	Committee for European Airspace Coordination
NADC	NATO Air Defence Committee

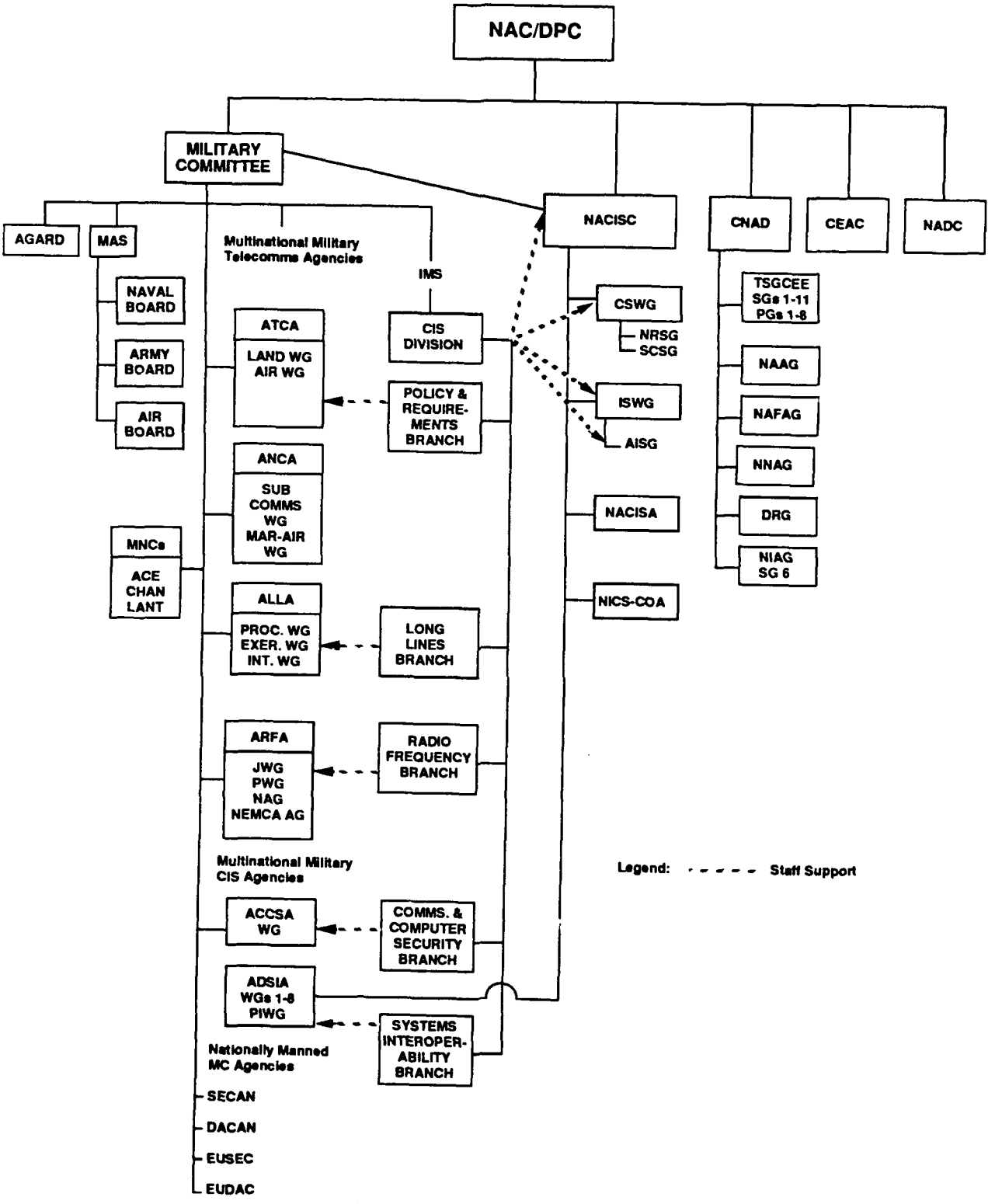

Figure F-2. (U) NATO Standards Bodies for Communications and Information Systems

have been left out and most of the names have been replaced with acronyms. Table F-1 provides the definitions of the acronyms for Figure F-2.

2.2 NATO OSI Standards Bodies

(U) TSGCEE SG9 has responsibility for the NATO OSI Reference Model and developing OSI STANAGs. SG9 also maintains the *NTIS Transition Strategy* [Ref. 4] that contains intercept recommendations.

(U) TSGCEE SG9 meets biannually, usually in March and October. Beginning in 1990, SG9 will meet approximately 6 to 8 weeks after the fall meetings of WG1 and WG2, to allow time for the nations to coordinate positions on issues developed by the working groups. Thus, the next meeting of SG9 is December 1990, while WG1 and WG2 will meet in October 1990. AHWGs meet approximately quarterly.

2.3 Standards Responsibilities of Selected NATO Bodies

(U) Table F-2 is an incomplete first draft of an effort to identify the specific responsibilities of NATO organizations for technical standards. Eventually, this and similar tables for other groups of standards bodies will be analysed to identify overlaps as well as possible gaps in the standards coverage.

Table F-2. (U) Responsibility for Standards in NATO Bodies

UNCLASSIFIED

NATO Organization	Title	Standards Responsibility
CNAD	Conf of Nat'l Armaments Directors	
TSGCEE	Tri-Serv Group Comm-Electron Equipment	Technical Standards
SG1	Tactical Area Communications	STANAGs 4206-4214,4249,4290,4295,5000-5018
SG2	Tactical Radio Equipment	STANAGs 4197-4205,4245-46,4285-92,4335-39,5020
SG3	Multi-Functional Info Distribution	
SG4	Navigation and Position Finding	
SG5	Identification	
SG7	Channel Eval Tech in HF Communications	
SG8	Tactical SATCOM Terminal	STANAGs 4231-33, 4271
SG9	Data Processing and Distribution	NATO OSI Standards; STANAG 4250
AHWG-Security	OSI Security	NATO OSI Standards (Annex B)
AHWG-OM	OSI Network Management	NATO OSI Standards (e.g., Net Mgmt)
AHWG-ISDN	Integrated Services Digital Network	ISDN Standards for Open Systems
WG1	Lower 4 Layers of Reference Model	STANAGs 4251-54, 4261-64
WG2	Upper 3 Layers of Reference Model	STANAGs 4255-56, 4258-59, 4265-66
AHWG-MMHS	Military Msg Handling System	STANAG 4257
WG3	Comm System/Network Interoperability	MOU for Multinational Programme
SG10	Geographic Information	
PG2	NATO Identification System	
PG3	MIDS	
PG4	Low Cost INS for Ships	
PG5	Multi-Functional Inertial Sensor Assembly	
PG6	Tac Comm Post 2000-Land Combat	
PG7	BICES	
PG8	Tactical Spectrum Mgmt System	
OGN	Conformance Testing	
NIAG	NATO Industrial Advisory Group	
SG6	Naval Data Handling Equipment	Functional Profiles
NACISC	NATO Comm and Info Sys Committee	Oversight for Procedural Standards
CSWG	Comm Systems Working Group	
ISWG	Information Systems Working Group	
AISG	Ada Implementation Subgroup	
NACISA	NATO Comm and Info Sys Agency	
NICS-COA	Central Operating Authority	
MC	Military Committee	
IMS	International Military Staff	
CCCS Div	Command, Control and Comm System	STANAGs 5000-6999
CISD	Comm and Info Systems Divison	
SIB	Systems Interoperability Branch	
MAS	Military Agency for Standardization	Operational Standards (STANAGs 1000-3999)
Air Board	Air Board	STANAGs 8000-8999
ACCSA	Allied Comm and Comp Sec Agency	
PSN WG	Packet Switched Network	
ADSIA	Allied Data Systems Interop Agency	Procedural Standards
PIWG	Permanent Interoperability WG	
WG1	Maritime TDS Interoperability Standards	Data Links 10, 11, and 14
WG2	Air Operations	
WG3	Land Forces TDSs	
WG4	Inter-Service Data Systems	Data Links 1,16; IJMS,SSSB; STANAG 5516
WG5	Character-Oriented	Language Development and Configuration Mgmt
WG6	Maritime Operations	
WG7	Intelligence Operations	Intelligence Messages
WG8	Common Operational Vocabulary	
SECAN	Comm Security and Eval Agency	

3. INTERNATIONAL STANDARDS BODIES

(U) Table F-3 identifies standards bodies from CCITT, ISO, and ECMA that recommend, develop, and maintain technical standards for communications and information processing. The primary international bodies are described below.[3] National standards bodies are identified in Chapter 4 of this appendix.

3.1 ISO/IEC

(U) The International Organization for Standardization (ISO) has 89 members representing national standards bodies (e.g., AFNOR in France, JISC in Japan, ANSI in the United States, BSI in the United Kingdom). The International Electrotechnical Commission (IEC)[4] is a federation of more than 200 national committees working in the area of electronics and electrical standards with specific interest in information processing. ISO and IEC have formed a joint committee, Joint Technical Committee One (JTC1), to develop standards for information processing systems.

3.2 CCITT/CCIR

(U) The Comite Consultatif International pour le Telephone et le Telegraph (CCITT) is the permanent organ of the Union Internationale des Telecommunications (UIT), which groups all the Postal Telephone Telegraph (PTT) administrations of the world's countries. CCITT develops standards in 4-year cycles and works closely with ISO to harmonize results. The Comite Consultatif International pour les Radiocommunications (CCIR) and the International Frequency Registration Board (IFRB) are the other two standards organs of the UIT; together with the CCITT, they are all based in Geneva.

3.3 CEN/CENELEC

(U) The Comite Europeen de Normalisation (CEN) is a grouping of the national organizations of 16 countries of the European Community (EC) and the European Free Trading Association (EFTA).[5] CEN works in cooperation with the Comite Europeen de Normalisation Electrotechnique (CENELEC) to develop and publish European standards [normes europeennes (ENs)]. CENELEC deals exclusively with electrotechnical standards and CEN works with standards in all other areas. Based in Brussels, CEN/CENELEC works to harmonize standards that are established by its members and to create European standards where no other appropriate standards exist. CEN/CENELEC members include AFNOR (France), UNI (Italy), DIN (Germany), BSI (United Kingdom), IBN (Belgium), DCQ (Portugal), and SIS (Sweden).

(U) CEN/CENELEC standards are initially distributed for comment by member bodies in the form of an experimental standard (ENV[6]) or a European prestandard (prENV). Future technical work in developing proposals for ENVs has now been taken over by the European Workshop for Open Systems

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3 (U) "La Galaxie de la Normalisation," Telecoms Magazine, 1989; *The OMNICON Index of Standards for Distributed Information and Telecommunication Systems*, OMNICON, 1987; and "The Value and Use of IT Standards in Public Procurement," PPSC-IT N268.1, Commission of the European Communities, August 1988, UNCLASSIFIED.

4 (U) The IEC is also known as the Commission Electrotechnique Internationale (CEI).

5 (U) The EFTA is also known as the Association Europeenne de Libre Exchange (AELE).

6 (U) The "V" in ENV is for "Vornorm," and indicates a standard based on DIS or other draft standards that are not completely stable; modifications to ENV standards may eventually be required to bring them in line with international standards. ENVs are valid for 3 years--they are reviewed after 2 years and may then become an EN, be prolonged for another 2 years, be replaced by another ENV, or be withdrawn.

Table F-3. (U) Responsibilities for Communications and Information Processing in International Civil Standards Bodies

UNCLASSIFIED

International Organization	Title	Standards Responsibility
CCITT	International Consult Comm Telephone Telegrams	
SG I	Definitions, Operation & Quality of Service	
SG II	Operation of Telecommunication Network & ISDN	
SG III	General Tariff Principles	
SG IV	Transmission Maintenance	
SG VII	Data Communication Networks	OSI standards; facilities, I/Fs
WG1	Network Services, Facilities, Prototypes	
WG2	Network Access Interfaces	
WG3	Internetworking, Switching, Signal	
WG4	Transmission & Message Handling	
WG5	Routing, Numbering, Layered Model	
SR ISDN	ISDN-Related Issues	
SR DEFs	Terms and Definitions	
SG VIII	Telematic Services	OSI standards; FAX, teletex, videotex
WG1	Terminal Characteristics	
WG2	Common Protocols & Internetworking	
SG IX	Telegraph Networks & Terminal Equipment	
SG X	Languages & Methodology for Telcomm Applications	
SG XI	ISDN & Telephone Network Switching	
SG XII	Transmission Performance of Telephone Network	
SG XV	Transmission Systems	
SG XVII	Data Transmission over Telephone Network	
SG XVIII	Digital Networks including ISDN	OSI standards for ISDN
CCIR	International Radio Consultant Committee	
CEN	European Communications for Standardization	
CENELEC	European Communications for Telecom Standardization	
CEPT	European Conf of Postal & Telecom Administration	
CCH	Harmonization Coordination Committee	
CAC	Commercial Action Committee	
CLTA	Liaison Committee for Transatlantic Telecommunications	
ECMA	European Computer Manufacturing Association	
TC29	Text Preparation & Interchange	Telematic services; text/office systems
TC32	Communications, Networks & Systems Interconnection	OSI standards
TG1	Public Data Networks	
TG3	Local Area Networks	
TG6	Interfaces to Private Switching Networks	
TG7	Transport & Network Layers	Layer 3 and Layer 4 OSI standards
COS	Corporation for Open Systems	
COSINE	Corporation for Open Systems in Europe	
EMUG	European MAP User Group	
ETSI	European Telecommunication Standards Institute	
EWOS	European Workshop on Open Systems	

Table F-3. (U) (Continued)

UNCLASSIFIED

International Organization	Title	Standards Responsibility
ISO	International Organization for Standardization	
JTC1 (TC97)	Technology Committee on Information Processing Systems	Promote standards worldwide
TSG-1	Tech Study Group on IAP	Interfaces for Application Portability
SC1	Vocabulary	
SC2	Character Sets & Information Coding	
SC6	Telecommunications and Info Exchange Between Systems	OSI standards
WG1	Data Link Layer	Layer 2 OSI standards
WG2	Network Layer	Layer 3 OSI standards
WG3	Physical Layer	Layer 1 OSI standards
WG4	Transport Layer	Layer 4 OSI standards
WG5	Architecture, Layers 1-4	OSI Architecture
SC7	Software Development & Systems Documentation	
WG2	Documentation	
WG3	Software Quality Characteristics	
SC11	Flexible Magnetic Media	
SC13	Interconnection of Equipment	
SC14	Representation of Data Elements	
SC15	Labelling and File Structure	
SC17	Identification and Credit Cards	
SC18	Text and Office Systems	Message handling protocols
WG4	Text Interchange	MOTIS
WG9	User System Interfaces & Symbols	
SC20	Data Cyrptographic Techniques	
SC21	Information Retrieval, Transfer, & Management	OSI and other standards
WG1	OSI Architecture	OSI architecture, concep schema
WG3	Database (not part of OSI)	
WG4	OSI Management	
WG5	Specific Application Services	Layer 7 (TM, FTAM, JTM, VT)
WG6	Session & Presentation Layers; ASCEs	Layer 5 and layer 6 OSI standards
WG7	Open Distribution Procedures (not part of OSI)	
SC22	Languages	
WG15	POSIX	
SC23	Optical Digital Data Disks	
SC24	Computer Graphics	(Work formerly done by SC21/WG2)
SC47B	Microprocessor Systems	
SC83	Information Technology Equipment	
IEC	International Electrotechnical Commission	
IFIP	International Federation for Information Processing	
ITSTC	Information Technology Steering Technology Committee	
OSITOP	OSI for Technical & Office Protocol	
OSF	Open Software Foundation	
POSI	Promotion Conference for OSI	Asia-Oceania workshop/standards forum
SOGITS	Senior Official Group for Info Tech Standardization	Commission of European Communities
SOGT	Senior Official Group on Telecommunications	Commission of European Communities
SPAG	Standards Application & Promotion Groups	
UER	European Union on Radiobroadcasting	
X/OPEN	X/OPEN	

(EWOS). When proposed international standards are harmonized with national standards, harmonized documents (HDs) are produced. When adopted, an HD must be used and national deviations can only exist temporarily. European norms (ENs) must be adopted as national standards, and any conflicting national standards must be withdrawn. An example standard is ENV 41201, Private Message Handling System. A second class of standards promulgated by CEN/CENELEC are the Telecommunications European Norms (NETs), which are common technical specifications covering access to networks and equipment. Examples are NET2 (X.25 Access) and NET3 (ISDN Basic Access).

(U) CEN/CENELEC standards originate as draft documents, standards proposals, and implementors guides developed by various standards promoting organizations. When stable, these documents are reviewed and coordinated by the European Telecommunications Standards Institute (ETSI) and EWOS and are issued for comment as functional specifications, recommendations, and technical specifications. When the review is complete, they are forwarded to CEN/CENELEC, or to the Conference Europeenne des Postes et Telecommunications (CEPT), for final standards development.[7]

3.4 ECMA

(U) The European Computer Manufacturer Association (ECMA) represents a group of about 30 manufacturers in Europe. ECMA, based in Geneva, acts as observer at ISO and as a consultant at CCITT. ECMA takes an active role in the definition of functional profiles with EWOS.

3.5 SPAG

(U) The Standards Application and Promotion Group (SPAG), based in Brussels, was created by 12 major European manufacturers (e.g., Bull, ICL, Siemens). SPAG seeks to accelerate standardization by selecting, among all OSI standards, a limited number for implementation. The stacks of standards are called profiles and are developed toward supporting complete applications, such as FTAM. SPAG has made a major contribution to the rapid progress of European experimental standards (ENVs) and standards (ENs).

3.6 OSITOP

(U) Open Systems Interconnection for Technical and Office Protocol (OSITOP) is an association of users (such as BNP, EDF/GDF) for the promotion of ISO functional profiles and the concept of TOP.

3.7 EMUG

(U) The European Manufacturing Automation Program (MAP) User Group (EMUG) was created in 1985 by a large group of manufacturers. It aims to promote the MAP standards in Europe. Specific groups in the nations, such as the Club Informatique des Grandes Enterprises Francaises (CIGREF) in France, are appointed to be EMUG's representatives. A key element of MAP, the Manufacturing Message Specification (MMS) has reached DIS status (DIS 9506).

3.8 EWOS

(U) The European Workshop on Open Systems (EWOS) promulgates harmonized technical proposals for functional profiles of OSI standards and corresponding conformance test specifications. EWOS has been given the responsibility for technical work in developing proposals for ENVs, with increased involvement of users. When complete, the proposals are submitted to CEN/CENELEC. The founding members of EWOS include CEN, CENELEC, ECMA, EMUG, OSITOP, Reseaux Associes pour le Recherche Europeenne (RARE, Association of European Research Networks), and the Corporation for

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[7] (U) Briefing on EUROPE 92--The European Community's Approach to Integration in the Information Technology Area, Fred Griefenstein, Softsiel Corporation, San Diego, 15 May 1989.

Open Systems Interconnection Networking in Europe (COSINE). The member bodies of EWOS have agreed not to undertake on their own any new work on the development of functional standards.

3.9 Support to the Commission of the European Community (CEC)

(U) The Senior Official Group for Information Technology Standardization (SOGITS) and the Senior Official Group on Telecommunications (SOGT) assist the CEC in the implementing legislation for information technology standards. The Public Procurement Subcommittee in the Information Technology Sector (PPSC-IT) enforces the role of standards in public procurement for the CEC.

3.10 ITSTC

(U) The Information Technology Steering Technical Committee (ITSTC) provides recommendations for European members in three areas: standards (the Information Technology Ad-hoc Expert Group for Standards), manufacturing/automation (the Information Technology Ad-hoc Expert Group for Manufacturing), and certification (the Information Technology Ad-hoc Expert Group for Certification). While the ITSTC does not produce standards, it does define programmes for European standards and organizes and coordinates the work.

3.11 CEPT/ETSI/UER

(U) Three consortia represent the interests of public telecommunication administrations of European countries, including France, the United Kingdom, and Germany. The Conference Europeenne des Postes et Telecommunications (CEPT) coordinates political aspects and prepares technical specifications for member administrations (but does not produce any standards). The CEPT has 20 member countries and works closely with CEN/CENELEC. The European Telecommunications Standards Institute (ETSI) is an organization created within CEPT to prepare specifications concerning public telecommunications networks. The Union Europeenne de Radiodiffusion (UER) is a technical committee with the aim of harmonizing radio broadcasting system standards; its proposals are transmitted to the CCIR and the IEC. The UER has 32 countries actively participating and 45 associated member bodies.

3.12 COS/COSINE

(U) The Corporation for Open Systems (COS) and the Corporation for Open Systems Interconnection Networking in Europe (COSINE) participate in the development of functional profiles for OSI and plays an active role in setting standards for testing OSI products for conformance to the international standards and profiles. COS is based in Vienna, Virginia, in the United States, and COSINE is based in Paris. COS has over 60 member organizations, both vendors and users.

(U) COSINE is a project established by the CEC to promote internetworking facilities between industrial and academic research and development communities throughout Europe. Participating countries are Austria, Belgium, Denmark, Finland, France, West Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and Yugoslavia. COSINE has been working closely with RARE in specifying standards initially to be used in a pan-European networking infrastructure.

3.13 X/OPEN

(U) X/OPEN is a non-profit consortium developing extensions to UNIX SVID operating system standards to support a distributed transaction processing environment that meets OSI standards. X/OPEN is developing a Common Applications Environment to promote software portability. Alignment of both activities with the emerging POSIX standards is planned.

3.14 OSF

(U) Created in 1988, the Open Software Foundation (OSF) is a group of over 90 information systems companies (including International Business Machines) for the promotion of standards, such as the POSIX standard for operating system interfaces.

3.15 IFIP

(U) The International Federation for Information Processing (IFIP) is a group of international experts drawn principally from universities and also from some industries (e.g., Xerox, Bell). IFIP has contributed to the work of ISO on the OSI model and, more recently, to the work on X.400-type message handling systems.

3.16 POSI

(NU) Created by six major vendors in Japan and the Nippon Telephone and Telegraph (NTT), the Promotion Conference for Open Systems Interconnection (POSI) is the equivalent to SPAG in Europe and to COS in the United States. POSI is an Asia-Oceania regional forum for the international workshops on OSI, and as such, seeks agreements among vendors to ensure interoperability and compatibility of products. The POSI regional workshop is known as the Asia-Oceania Workshop (AOW).

4. NATIONAL STANDARDS BODIES

(U) This section identifies national standards bodies and their responsibilities for standards development or use.[8] Additional contributions to this section would be welcomed.

4.1 Belgium

(U) The Institut Belge de Normalisation (IBN) is the primary standards body for Belgium.

4.2 Canada

(U) The Canadian Standards Association (CSA) is responsible for the development of OSI standards in Canada. The Standards Council of Canada (SCC) is a Canadian national non-governmental agency that develops standards policy. The SCC provides coordination and support for the National Standards System (NSS) and supports Canada's participation in international standards work.

4.3 Denmark

(U) Danish Standards Association (Dansk Standardiseringsrad) is the ISO member body from Denmark. It is also the member body for CEN.

4.4 France

(U) The Association Francaise de Normalisation (AFNOR) is the French official organization for normalization/standardization and the French member body for ISO. It works with manufacturers, users, and administration. It promulgates international standards in France, chooses working groups in which France is to take an active part, manages French technical experts, and defines/coordinates the proposals they must put forward in discussions. The AFNOR role also includes giving information--it sends out literature on national and international standards and answers questions from manufacturers and users. AFNOR standards are classified according to the activity to which they relate. For example, Class Z corresponds to data processing. The Union Technique de l'Electricite (UTE) is the member of CENELEC

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8 (U) *The OMNICON Index of Standards for Distributed Information and Telecommunication Systems*, OMNICON, 1987, UNCLASSIFIED.

from France and an active participant in AFNOR for the development and exploitation of standards for electricity and electronics.

4.5 Germany

(U) The Deutsches Institut fur Normung (DIN) is the official organization for standardization for the Federal Republic of Germany and Berlin (West) and is the member body of ISO and CEN.

4.6 Netherlands

(U) The Nederlands Normalisatie-Instituut (NNI) is the ISO member body for the Netherlands. When ISO or CCITT standards are translated or modified, they are issued by NNI as NENs. For example, NEN-ISO 3309 is a translation of an ISO HDLC standard.

4.7 United Kingdom

(U) The British Standards Institute (BSI) is the UK member of ISO and the recognized body for the preparation and promulgation of British national standards.

4.8 United States

(U) The American National Standards Institute (ANSI) is the US member of ISO and a US clearinghouse for voluntary standards.

(U) Table F-4 identifies ANSI and other standards bodies[9] in the United States, both civil and military, that recommend, develop, manage, and maintain technical standards for communications and information processing.

(NU) Table F-5 identifies all the current Technical Committees (TCs) currently active in ANSI for Infomation Processing Systems (X3).

4.9 Standards Bodies in Non-NATO Nations

(U) Finland is represented in ISO and IEC by the Suomen Standardisoimisliitto (SFS).

(U) Sweden is represented in ISO by the Standardiseringskommisionen i Sverige (SIS). SIS coordinates with the Swedish Electrical Commission (SEK) and the Swedish Mechanical Standardization (SMS).

(U) The Irish member of ISO and CEN is the National Standards Authority of Ireland (NSAI), an autonomous unit of the Institute for Industrial Research and Standards (IIRS).

(U) The Japanese Industrial Standards Committee (JISC) oversees the Japanese Industrial Standards (JISs). The JISC is attached to the Agency of Industrial Science and Technology, Ministry of International Trade and Industry (MITI). JISC members include representatives from manufacturers, consumers, and knowledgeable individuals. Texts of standards approved by the relevant Minister and announced in the Government Gazette are published by the Japanese Standards Association (JSA). An Information Technology Standardization Technology Committee (INSTAC) within the Japanese Standards Association, the Telecommunications Technology Committee (TTC), the Interoperability Database System Development Project, and the Interoperability Association for Information Processing (INTAP) were established in 1985 to promote interoperability technology. INTAP has the responsibility to develop functional standards and conformance tests for OSI in Japan.

(U) The Saudi Arabian Standards Organization (SASO) represents Saudi Arabia in ISO and IEC.

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9 (U) Similar tables need to be developed for standards bodies in other nations. Additional contributions will be included in future editions of this working paper.

Table F-4. (U) Responsibilities for Communications and Information Processing in US Standards Bodies

UNCLASSIFIED

U.S. Organization	Title	Standards Responsibility
ANSI X3	Information Processing	
X3S3	Technology Committee (TC) on Data Communications	Devel of US OSI standards; input to ISO JTC1/SC21
X3S3.1	Task Group on Data Communications Planning	General standardization efforts
X3S3.2	Task Group on Communications Vocabulary	Data transmission vocabulary
X3S3.3	Task Group on Network & Transport Layers	Directory, management, routing, ISDN
X3S3.4	Task Group on Data Link Layer	Protocols, procedures, & management; X.25
X3S3.5	Task Group on Quality of Service	Nomenclature, presentation & performance measurement
X3S3.7	Task Group on Public Data Network Access	ISDNs, gateways (X3.100, X.25, X.75, X.32)
X3T1	Technology Committee on Data Encryption	
X3T2	Technology Committee on Data Exchange	
X3T5	Technology Committee on OSI	Development of US OSI standards; input to ISO JTC1/SC21
X3T5.1	OSI Architecture; Reference Model	FDTs; Conf Testing; Sec, Open Distributed Proc
X3T5.4	Task Group on OSI Management Protocols	Management, MIS, directory service
X3T5.5	Session, Presentation, Application--Upper 3 Layers	CL mode, VT, ANS.1
X3T9	Technology Committee on I/O Interface	
X3T9.2	Task Group on lower level interface	
X3T9.3	Task Group on device level interface	
X3T9.5	Task Group on local distribution data interface	
X3V1	Office and Publishing Systems	
USCCITT	US Organization for CCITT	
NC	National Committee	
GS-A	Telecommunication policies & services	
SG-B	WATTC-1988	
SG-C	Worldwide telephone network	
SG-D	Data and ISDN	
JWP	Joint Working Party on ISDN	
IEEE	Institute for Electrical and Electronic Engineering	
802	Committee on Local Area Networks	
Ad-hoc	Study Group on Functional Requirements	
802.1 .	Overall architecture of LANs/internetwork	
802.1A	Glossary	
802.1B	Network Management	
802.2 x	Logical link control	
802.3 .	CSMA/CD	
802.4 .	Token-passing bus access methodology	
802.5 .	Token ring access methodology	
802.6 .	Metropolitan area networks	
802.7 .	Broadband tech adv group	
802.8 .	Fiber-optics tech adv group	
802.10 .	Secure local area networks	
P1003	POSIX	
COS	Corporation for Open Systems	Promote OSI; conformance testing
X/OPEN	X/OPEN	Promote portability and use of OSI
NIST	National Institute for Standards & Techology	Standards development and coordination; conformance
Workshops	Implementation Workshops	Develop design-to functional profiles
ASD(C3I)	Asst Sec Def C3I	
DASD C3	Deputy Assistant Secretary of Defense C3	
T&TC3	Theater and Tactical C3	Interoperability of C3 systems
IS	Information Systems	DoD transition to GOSIP
ASD(P&L)	Production and Logistics	
S&DS	Standardization & Data Management	Distribution of standards

Table F-4. (U) (Continued)

UNCLASSIFIED

U.S. Organization			Title	Standards Responsibility
DIA			Defense Intelligence Agency	
DCA			Defense Communications Agency	DoD Executive Agent for data comm protocol standards
	DCS Organ		Defense Communications System Organization	
		DCEC	Defense Communications Engineering Center	Lead on standards for long haul communications
	JTC3A		Joint Tactical C3 Agency	Lead for tactical communication technical standards
		JINTACCS	Joint Interoperability Tactical C2 Systems Program	Joint message standards
		JMSWG	JTIDS Message System WG	TADIL J; J-Series messages and protocols
		FSSG	Fire Support Subgroup	K-Series messages (and protocols)
		JITF	Joint Interface Test Force	Testing Joint interfaces
		JITC	Joint Interoperability Test Center	Testing Joint interfaces
	JDSSC		Joint Data Systems Support Center	
		WIS	WWMCCS Information System	
	JSC		Joint Steering Committee	Develop common interoperability standards
	PSSG		Protocol Standards Steering Group	Primary advisory body for standards policy issues
		TP	Technical Panel	
DLA			Defense Logistics Agency	
	DMSSO		Defense Materiel Specifications & Standards Office	
NSA			National Security Agency	
JCS	J-6J		Joint Tactical C3 Systems Division	Ensure interoperability of TDSs
	MCEB		Military Communications-Electronics Board	Coordinate representation to international standards bodies
USA	DISC4		Director, Information Systems for C4	Technical requirements, interoperability
		SAIS-ADO	RSI-Rationalization, Standards, & Interoperability	Interoperability and standards
	DCSOPS		International RSI	Operational requirements, interoperability
	PEO CCS		PEO Command & Control Systems	Interoperability of Army Tactical C2 Systems
	PEO Comm		PEO Communications	Interoperability of Communications Systems
	AMC		Army Materiel Command	Materiel standards
		ICP-M	Office of International Cooperative Programs	
		CECOM	Communications & Electronics Command	
		ISD	Interoperability & Standardization Directorate	Technical support and POC for standards
	TRADOC		Training and Doctrine Command	
		CACDA	Combined Arms Combined Development Activity	Operational and procedural standards
		SIGCEN	Signal Center	Communications standards
	USAISC		Information Systems Command	
		ISEC	Information Systems Engineering Command	
USN	Info MGT		Information Management	
	ASN RE&S/C3I&Space		C3I and Space	
	CNO/SPAWAR		Space & Naval Warfare Systems Command	
	CNO/Space,C2		Space & C2	
		OP-945	Information Management Support	
		NAVDAC	Naval Data Automation Command	
USMC	MCRDAC	SI	Systems Integration	Standards
	MCCDC-WC		Warfighting Center	Requirements
	D4 Div	P&I	Planning and Interoperability	Standards coordination
USAF	AQ/DAS C4		Acquisitions--C4	
	ACS C4 Sys		C4 Systems	
	AF Comm Cmd		Communications Command	
	AFSC		Air Force Systems Command	
		ESD	Electronic Systems Division	
		RADC	Rome Air Development Center	
	TAC	DRI	Tactical Air Command	

Table F-5. (U) ANSI X3 Technical Committees

UNCLASSIFIED

X3A1	Optical Character Recognition	X3J11	C
X3B5	Digital Magnetic Tape	X3J12	DIBOL
X3B6	Instrumentation Tape	X3J13	LISP
X3B7	Magnetic Disks	X3J14	FORTH
X3B8	Flexible Disk Cartridges	X3J15	DATABUS
X3B9	Paper/Forms Layout	X3K1	Computer Documentation
X3B10	Credit/Identificaton Cards	X3K5	Vocabulary
X3B11	Optical Digital Data Disks		
		X3L2	Codes & Character Sets
X3H2	Database	X3L8	Data Representation
X3H3	Computer Graphics		
X3H4	Information Resource	X3S3	Data Communications
X3J1	PL/1	X3T1	Data Encryption
X3J2	BASIC	X3T2	Data Interchange
X3J3	FORTRAN	X3T3	Open Distributed Processing
X3J4	COBOL	X3T5	Open Systems Interconnection
X3J7	APT	X3T9	I/O Interface
X3J9	PASCAL		
X3J10	APL	X3V1	Text: Office & Publishing Systems

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APPENDIX G

STATUS OF OPEN SYSTEMS STANDARDS DEVELOPMENT IN ISO/IEC

STATUS OF OPEN SYSTEMS STANDARDS DEVELOPMENT IN ISO/IEC

1. INTRODUCTION

(U) This appendix provides an overview of the work plans of selected technical committees and working groups in ISO/IEC. The purpose is to illustrate how rapidly international civil standards are being progressed in those areas applicable to ATCCIS. A compilation of ISO/IEC and CCITT standards relevant to ATCCIS is provided in Appendix D (by layer of the OSI Reference Model) and Appendix E (numerical listing). An overview of international standards bodies and their responsibilities for standards development is provided in Appendix F.

2. INFORMATION PROCESSING STANDARDS (JTC1)

(U) Table G-1 provides an overview of the work plans for the major working groups of ISO/IEC JTC1 SC21, whose responsibility is Information Retrieval, Transfer, and Management for OSI. The standards bodies included in this table are:

- WG1 on OSI Architecture
- WG3 on Database
- WG4 on OSI Management
- WG5 on Specific Application Services
- WG6 on Session and Presentation Layers
- WG7 on Open Distributed Processing.

(U) The symbols used in Table G-1 show the progress of a standard from its submission as a working draft (circulated to SC21), through the intermediate stages of committee draft (CD) or draft proposal (DP) and draft international standard (DIS), in becoming an international standard. In many areas, balloting as an international standard is planned for 1992 or earlier.

Table G-1. (U) Status of Standards Development in ISO/IEC JTC1

UNCLASSIFIED

WG1 OSI ARCHITECTURE	CURRENT STANDARD	1990	1991	1992
Database Management Systems	?			
OSI Basic Reference Model	ISO 7498	WD	DIS	ISO
Connectionless data transmission	AD1			
Multipeer data transmission (MPDT)	DAD2	SUSPENDED		
OSI Service conventions	TR 8509	DP/CD	DIS	ISO
Security architecture	ISO 7498-2			
Naming and addressing	DIS 7498-3			
Formal Description Techniques (FDTs)	-			
Estelle	IS 9074			
LOTOS	ISO 8807			
Conformance Testing Methodology and Framework	DIS 9646			
Part 1: General aspects	DIS 9646-1	ISO		
Part 2: Abstract test suite specifications	DIS 9646-2	ISO		
Part 3: TTCN	DIS 9646-3	ISO		
Part 4: Test realisation	DIS 9646-4	ISO		
Part 5: Requirements on Test Labs. and clients	DIS 9646-5	ISO		
Part 6: Multipart test tools and methods	DP 9646-6	DP/CD	DIS	ISO
Architectural Semantics for FDTs	SC21 N5116	DP/CD	DIS	ISO
Guidelines for Application of Estelle, LOTOS and SDL	DTR 10167	DIS		
Security Frameworks in Open Systems	DP 10181	DP/CD - - - - -	DP/CD DIS - - - -	- - - - - DIS

WG3 DATABASE	CURRENT STANDARD	1990	1991	1992
Database Languages:	-			
NDL	ISO 8907			
SQL	ISO 9075			
SQL Addendum 1	AD1			
SQL 2	CD 9075.2	DIS		ISO
SQL 3	WD 9075.3		WD	DP/CD
Information Resource Dictionary System (IRDS):	-			
Framework	IS 10027	ISO		
Services Interface	SC21 N5147	WD	DP/CD	DIS
Export/import	SC21 N5137	WD	DP/CD	DIS
Command language and panel interface	DP 8800-1	SUSPENDED		
Support for SQL 1 with integrity enhancement	ISO 9075			
Reference Model of Data Management	CD 10032.2	DP/CD	DIS	ISO
Technical report on model of data magement	SC21-4119		WD	DP/CD
Remote Database Access (RDA)	DP 9579-1		DIS	ISO
SQL specialization	DP 9579-2		DIS	ISO
SQL 2 specialization	WDAM-1		WD	DP/CD
Tutorial	SC21 N3343		DP/CD	DIS

Key: WD, DP/CD, DIS, ISO

Sources: Alan Paton, "Standard Status - SC21 Information Retrieval, Transfer, and Management for OSI," *OSN: The Open System Newsletter*, Volume 2, Issue 5, Technology Appraisals, Limited, London, July 1988 (used with permission); work plans provided in SC21 documents through July 1990; and private communication with Alan Paton, 19 July 1990.

Table G-1. (U) (Continued)

UNCLASSIFIED

WG4 OSI MANAGEMENT	CURRENT STANDARD	1990	1991	1992
OSI Management				
OSI systems management tutorial	SC21 N 4942			
OSI Management Information Service:	-			
System Management (SM) Overview	DIS 10040			
Structure of management information	DIS 10165			
Common information management service (CMIS)	ISO 9595			
Addendum 1,2: Cancel Get, Add/Remove	DAD 1,2			
Common info management protocol (CMIP)	ISO 9596			
Addendum 1,2: Cancel Get, Add/Remove	WDAD 1,2			
SM: Configuration management	DIS10164-1,2,3			
SM: Fault management	DIS 10164-4-6			
SM: Accounting management	DIS 10164-10			
SM: Performance management	DIS 10164-11			
SM: Security managemt	DIS 10164-7,8,9			
SM: Software management	DIS 10164-X			
OSI The Directory	ISO 9594			
Part 1: Overview	ISO 9594-1			
Part 2: Information framework	ISO 9594-2			
Part 3: Abstract service definition	ISO 9594-3			
Part 4: Distributed operations	ISO 9594-4			
Part 5: Protocol specification	ISO 9594-5			
Part 6: Selected attribute types	ISO 9594-6			
Part 7: Selected object classes	ISO 9594-7			
Part 8: Authentication-framework	ISO 9594-8			
Part 9: DIT structure and naming	WD 9594-9			
Part 10: Replication and knowledge management and addendum to parts 2, 3, 4, 5.	WD 9594-10			
Addendum to Parts 1-7; support of nameform 2	PCDAMs			
Addendum to Parts 2, 5, 6, 7: schema	PCDAMs			
Addendum to Parts 2 ,3, 4, 5: access control	PCDAMs			

WG7 OPEN DISTRIBUTED PROCESSING	CURRENT STANDARD	1990	1991	1992
Open Distributed Processing (Reference Model)	SC21 N3192	(CD text expected June 1994)		

Key: ☐ WD ☒ DIS ⊡ DP/CD ■ ISO

Sources: Alan Paton, "Standard Status - SC21 Information Retrieval, Transfer, and Management for OSI," *OSN: The Open System Newsletter*, Volume 2, Issue 5, Technology Appraisals, Limited, London, July 1988 (used with permission); work plans provided in SC21 documents through July 1990; and private communication with Alan Paton, 19 July 1990.

Table G-1. (U) (Continued)

UNCLASSIFIED

WG5 SPECIFIC APPLICATION SERVICES	CURRENT STANDARD	1990	1991	1992
Operating System Command and Response Language	DP xxxx	INACTIVE		
OSCRL Overview	?			
OSCRL Specification	?			
Virtual Terminal Services and Protocols (VT)	-			
Basic class VT service	ISO 9040.2	■		
Add. 1 on extended facility set	AD 1	■		
Add. 2 on additional functional units	PDAD 2	▨	■	
Basic class VT protocol	ISO 9041.2	■		
Add. 1 on extended facility set	AD1	■		
Add. 2 on additional functional units	PDAD 2	▨	■	
Register of VT profiles	DIS 9834-4	▨ - -▨	■	
Register of VT control objects	DIS 9834-5	▨ - -▨	■	
File Transfer, Access and Management (FTAM)	ISO 8571			
Part 1: General description	ISO 8571-1			
Part 2: Virtual filestore	ISO 8571-2			
Part 3: File service definition	ISO 8571-3			
Part 4: File protocol specification	ISO 8571-4			
FTAM overlapped access - Parts 1,2,3,4,5	PDAD 2	▣ ▨	■	
FTAM Filestore management- Parts 1,2,3,4,5	DAM1	▨	■	
FTAM PICS proforma	ISO 8571-5	■		
Job Transfer and Manipulation (JTM)	-			
Concepts and Services	ISO 8831			
Basic class protocol	ISO 8832			
Full class protocol	DAM1	▨	■	
Checkpointing addendum	?	INACTIVE		
Registration of document types	DIS 9834-2	▨ - -▨	■	
Transaction Processing (TP)	DIS 10026			
Model	DIS 10026-1	▨	■	
Service	DIS 10026-2	▨	■	
Protocol	DIS 10026-3	▨	■	
Terminal Management (TM)	CD 10184			
Model	CD 10184-1	▣	▨	■
Service	WD 10184-2	□- - -□	▨	■
Protocol	WD 10184-3	□- - -□	▨	■
Conformance Test Suites for FTAM	DIS 10170			
Test suite structure and purpose	DIS 10170-1	▨	■	
Abstract test suite	WD 10170-2	▣	▨	■
Abstract test suite embedded under FTAM	WD 10170-3		□	▣
Presentation abstract test suite embedded under FTAM	WD 10170-4		□	▣
Session abstract test suite embedded under FTAM	WD 10170-5		□	▣

Key: □ WD ▣ DP/CD ▨ DIS ■ ISO

Sources: Alan Paton, "Standard Status - SC21 Information Retrieval, Transfer, and Management for OSI," *OSN: The Open System Newsletter*, Volume 2, Issue 5, Technology Appraisals, Limited, London, July 1988 (used with permission); work plans provided in SC21 documents through July 1990; and private communication with Alan Paton, 19 July 1990.

Table G-1. (U) (Continued)

UNCLASSIFIED

WG6 OSI SESSION, PRESENTATION, AND APPLICATION SERVICE ELEMENTS	CURRENT STANDARD	1990	1991	1992
Data Descriptive File for Information Interchange	ISO 8211			
Upper Layer Architecture Addendum (ULA) to ISO 7498-1	PDAD3			
Session Layer Services and Protocols:	-			
Service definition	ISO 8326	■		
Protocol specification	ISO 8327	■		
Formal description of session	TR 9571, 72			
Symmetric sync addendum	AD 1	■		
Unlimited user data addendum	AD 2	■		
Session PICS proforma	CD 8327-2	⊡ ▨	■	
Presentation Layer Services and Protocols:	-			
Service definition	ISO 8822			
Protocol specification	ISO 8823			
Specification for ASN.1	ISO 8824			
Addendum 1 to specifications for ASN.1	AD1			
Basic encoding rules for ASN.1	ISO 8825			
Addendum 1 to basic encoding rules	AD 1			
Symmetric synchronisation	WDAM 2	□ ⊡	▨	■
PICS proforma	DIS 8823-2	▨	■	
Registration Authority Procedures	DIS 9834			
Part 1: General procedures	DIS 9834-1	▨ - - ▨	■	
Part 2: OSI document types	DIS 9834-2	▨ - - ▨	■	
Part 3: Object identifies component values	ISO 9834-3	■		
Part 4: VTE profiles	DIS 9834-4	▨ - - ▨	■	
Part 5: VT control objects	DIS 9834-5	▨ - - ▨	■	
Association Control Service Element (ASCE):	-			
Application layer structure (ALS)	ISO 9545	■		
Addendum for connectionless (CL) mode	WDAD 1	□	⊡	▨
Service definition for ACSE	ISO 8649			
Addendum on authentication	AD 1	■		
Addendum on A-context management	AM 2	■		
Commitment concurrency and recovery service (CCR)	ISO 9804.2	■		
Addendum on enhancements	CDAD 1	⊡	▨	■
Addendum on restart	WDAD 3		□	⊡
Specification of Protocols for ACSE:	-			
Protocol specification for ACSE	ISO 8650			
Addendum covering Authentication	DAD 1	■		
Addendum covering A-context management	AM 2			
Protocol amendment for PICS	DIS 8650-2	▨	■	
Protocol amendment for application titles	DP 9834-6	▨	■	
Commitment concurrency and recovery protocol (CCR)	ISO 9805.2	■		
Add. for checkpointing to CCR global restart points	AD 1			
Presentation of Numerical Values in Character Strings	?	INACTIVE		
Conformance Test Suites:	DIS 10168			
Session Part 1: Test suite structure and purposes	DIS 10168-1	▨	■	
Session Part 2: Generic test suite	WD 10168-2			⊡
Session Part 3: Abstract test suite for CS Method	WD 10168-3		□	⊡
Presentation Part 1: test suite structure and purpose	SC21 N5019	⊡ ▨	■	
ACSE Part 1: Test suite structure and purpose	DIS 10169-1		■	
Session CL Protocol to Provide CL Mode	ISO 9548			
CL Addendum to the Session Service	ISO 8326 AD3			
CL Addendum to the Presentation Service	DIS 8822 AD1	■		
CL Presentation Protocol	ISO 9576	■		

Key: □ WD ▨ DIS ⊡ DP/CD ■ ISO

Sources: Alan Paton, "Standard Status - SC21 Information Retrieval, Transfer, and Management for OSI," *OSN: The Open System Newsletter*, Volume 2, Issue 5, Technology Appraisals, Limited, London, July 1988 (used with permission); work plans provided in SC21 documents through July 1990; and private communication with Alan Paton, 19 July 1990.

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APPENDIX H

INTERNATIONAL MILITARY AND OTHER STANDARDS FOR OPEN SYSTEMS

INTERNATIONAL MILITARY AND OTHER STANDARDS BASED ON OSI STANDARDS OR USED IN OPEN SYSTEMS PROFILES

I. NATO STANDARDS

A. OSI STANAGs

STANAG 4250♦	NATO Reference Model for OSI, NATO UNCLASSIFIED
STANAG 4250-1♦	Part 1--General Description, Revised Draft, May 1990, NATO UNCLASSIFIED
STANAG 4250-2♦	Part 2--Security, Draft (SANISI Document), NATO SECRET
STANAG 4250-3♦	Part 3--Naming and Addressing, Draft (Working Paper), NATO UNCLASSIFIED
STANAG 4250-4♦	Part 4--Management, Draft (Working Document), NATO UNCLASSIFIED
STANAG 4250-5♦	Part 5--Military Features, Draft (Working Document), NATO UNCLASSIFIED
STANAG 4251♦	NATO Reference Model for OSI - Layer 1 (Physical Layer) Service Definition, Draft, 13 July 1990, NATO UNCLASSIFIED
STANAG 4252♦	NATO Reference Model for OSI - Layer 2 (Data Link Layer) Service Definition, Draft, 6 July 1990, NATO UNCLASSIFIED
STANAG 4253♦	NATO Reference Model for OSI - Layer 3 (Network Layer) Service Definition, Draft, July 1990, NATO UNCLASSIFIED (Appendix B is NATO CONFIDENTIAL)
STANAG 4254♦	NATO Reference Model for OSI - Layer 4 (Transport Layer) Service Definition, Draft, July 1990, NATO UNCLASSIFIED
STANAG 4255♦	NATO Reference Model for OSI - Layer 5 (Session Layer) Service Definition, Draft, 12 April 1990, NATO UNCLASSIFIED
STANAG 4256♦	NATO Reference Model for OSI - Layer 6 (Presentation Layer) Service Definition, Draft, 19 January 1990, NATO UNCLASSIFIED
STANAG 4257♦	NATO Standard Profile on Military Message Handling System (MMHS), Draft, 16 February 1990, NATO UNCLASSIFIED
STANAG 4258♦	Specification of ASN.1, Draft, 15 January 1990, NATO UNCLASSIFIED
STANAG 4259♦	Specification of Basic Encoding Rules for ASN.1, Draft, 15 January 1990, NATO UNCLASSIFIED
STANAG 4261♦	NATO Reference Model for OSI - Layer 1 (Physical Layer) Protocol Specification, Draft, 13 July 1990, NATO UNCLASSIFIED
STANAG 4262♦	NATO Reference Model for OSI - Layer 2 (Data Link Layer) Protocol Specification, Draft, 6 July 1990, NATO UNCLASSIFIED
STANAG 4263♦	NATO Reference Model for OSI - Layer 3 (Network Layer) Protocol Specification Draft, July 1990, NATO UNCLASSIFIED
STANAG 4264♦	NATO Reference Model for OSI - Layer 4 (Transport Layer) Protocol Specification, Draft, July 1990, NATO UNCLASSIFIED

STANAG 4265♦	NATO Reference Model for OSI - Layer 5 (Session Layer) Protocol Specification, Draft, 12 April 1990, NATO UNCLASSIFIED
STANAG 4266♦	NATO Reference Model for OSI - Layer 6 (Presentation Layer) Protocol Specification, Draft, 19 January 1990, NATO UNCLASSIFIED
STANAG xxxx♦	NATO Standard Profile on R.131(M), Draft, 1989, NATO UNCLASSIFIED
STANAG xxxx♦	NATO Standard Profile on TC 111(M) - Connection-Mode Transport Service Over Connection-Mode Network Service - Permanent Access to a Packet Switched Data Network (Military), Draft, Version 1.3, 13 July 1990, NATO UNCLASSIFIED
STANAG xxxx♦	NATO Standard Profile on TA 51(M) - Interface Between a Reference End System That Provides the Connection-Mode Transport Service (CO-TS) Over the Connectionless-Mode Network Service (CL-NS) and a CSMA/CD LAN of Types 10Base2 and 10Base5, Draft, Version 2.0, 23 July 1990, NATO UNCLASSIFIED

B. OTHER STANAGs

STANAG 4146	Interim Specifications for Input/Output Interfaces in NATO Naval Data Handling Equipment
STANAG 4153	Standard Specification for an Asynchronous Serial Data Interface for Point to Point Connections and for Connection to Data Networks in NATO Naval Systems
STANAG 4156	Standard Specification for a Serial Data Interface for Synchronous Connections to a Data Network
STANAG 4175	Multi-Functional Information Distribution System
STANAG 4197	Modulation and Coding Characteristics that must be Common to Assure Interoperability of 2400 BPS Linear Predictive Encoded Digital Speech Transmitted Over HF Radio Facilities
STANAG 4198	Parameters and Coding Characteristics That Must Be Common to Assure Interoperability of 2400 BPS Linear Predictive Encoded Digital Speech
STANAG 4199	Uniform System of Exchange of Materiel Management Data
STANAG 4202	Transmission Envelope Characteristics for High Reliability Data Exchange between Land Tactical Data Processing Equipment Over Single Channel Radio Links
STANAG 4203	Technical Standards for Single Channel HF Radio Equipment
STANAG 4204	Technical Standards for Single Channel VHF Radio Equipment
STANAG 4205	Technical Standards for Single Channel UHF Radio Equipment
STANAG 4206	The NATO Multichannel Tactical Digital Gateway-System Standards
STANAG 4207	The NATO Multi-Channel Tactical Digital Gateway - Multiplex Group Framing Standards
STANAG 4208	The NATO Multi-Channel Tactical Digital Gateway - Signalling Standards
STANAG 4209	The NATO Multi-Channel Tactical Digital Gateway - Standards for Analogue to Digital Conversion of Speech Signals
STANAG 4210	The NATO Multi-Channel Tactical Digital Gateway - Cable Link Standards
STANAG 4211	The NATO Multi-Channel Tactical Digital Gateway - System Control Standards
STANAG 4212	The NATO Multi-Channel Tactical Digital Gateway - Radio Relay Link Standards
STANAG 4213	The NATO Multi-Channel Tactical Digital Gateway - Data Transmission Standards
STANAG 4214	International Routing and Directory for Tactical Communication Systems
STANAG 4231	Digital Interoperability Between UHF Tactical Satellite Communications Terminals
STANAG 4232	Digital Interoperability Between SHF Tactical Satellite Communications Terminals
STANAG 4233	Digital Interoperability Between EHF Tactical Satellite Communications Terminals

STANAG 4234	Radio Frequency Environmental Conditions Affecting the Design of Materiel for Use by NATO Forces
STANAG 4245	Secure and ECM Resistant HF Low Speed Digital Data Communications System
STANAG 4246	Have Quick and UHF Secure Jam Resistant Communications Equipment
STANAG 4249	NATO Multi-Channel Tactical Digital Gateway - Data Transmission Standards (Packet Switching Service)
STANAG 4250	The NATO Reference Model for Open Systems Interconnection - Overview
STANAG 4261	The NATO Reference Model for Open Systems Interconnection- Layer 1 (Physical Layer) Protocol Specification
STANAG 4262	The NATO Reference Model for Open Systems Interconnection - Layer 2 (Data Link Layer) Protocol Specification
STANAG 4263	The NATO Reference Model for Open Systems Interconnection - Layer 3 (Network Layer) Protocol Specification
STANAG 4271	ECM Resistant Digital Traffic Exchange Between Tactical Satellite Communications Terminals
STANAG 4285	Characteristics of a 1200/2400 Bits Per Second Single Tome Modulator/Demodulator for HF Radio Links
STANAG 4290	NATO Multi-Channel Tactical Digital Gateway - Cable Link (Optical) Standards
STANAG 4291	Modulation and Coding Characteristics that must be Common To Assure Interoperability of 2400 BPS Wireline Modems for Use in Narrow-Band Secure Voice Systems
STANAG 4292	Standards to Achieve Communications Between Tactical Combat Net Radio Equipment Designed to STANAG 4202 and Frequency Hopping Radios Operating in the Same VHF Band
STANAG 4295	Significant Data and Telegraph Signalling Conditions
STANAG 5000	Interoperability of Tactical Digital Facsimile Equipment
STANAG 5004	Military Characteristics for Field Telephone Sets (Minimum Standard)
STANAG 5009	(Exact Title Unknown - Relates to Naval Gunfire Support Using HF Radio)
STANAG 5018	NATO Manua' Interface Between the Manual Switched Telecommunications Systems of the Combat Zone
STANAG 5020	Interoperability of Aircraft UHF Multi-Frequency Transceiver Installation and Compatible Ground Transmitters and Receivers
STANAG 5026	Military Characteristics for Facsimile Equipment To Meet Meteorological Requirements
STANAG 5028	Significant Telegraph Signalling Conditions in Automatic Telegraphy [Morse and International Alphabet (IA) No. 2]
STANAG 5030	Single and Multichannel VLF and LF On-Line Broadcast and Off-Line OOK Systems
STANAG 5031	Introduction of Modern Audio Equipment for Naval HF-MF and LF Shore-to-Ship Broadcasts
STANAG 5032	HF Single Sideband Single Channel Voice Communications (exact title unknown)
STANAG 5035	Introduction of an Improved System for Maritime Air Communications on HF, LF and UHF
STANAG 5036	Parameters and Practices for the Use of the NATO 7-Bit Code
STANAG 5038	Interoperability of Ship UHF Transmitting and Receiving Systems
STANAG 5040	NATO Automatic and Semi-Automatic Interfaces Between the National Switched Telecommunications Systems of the Combat Zone and Between These Systems and the NICS from 1979 to the 1990's

STANAG 5501	Point-to-Point Digital Data Link - Link 1
STANAG 5504	Tactical Data Link for the Control of Aircraft - Link 4
STANAG 5505	NATO Standard Bit Fields, Bit Field Fillers and Codes
STANAG 5506	Link 6 SAM/NADGE Link
STANAG 5507	Link 7 Airspace/Air Traffic
STANAG 5510	Maritime Tactical Data Exchange - Link 10
STANAG 5511	Tactical Data Exchange - Link 11
STANAG 5514	Tactical Data Broadcasting - Link 14
STANAG 5516	Tactical Data Exchange - Link 16
STANAG 5550	NATO Standard Data Elements, Data Items and Codes
STANAG 5601	Standards for Interface of NATO Data - Links 1, 11, 14, and TADIL B Through A Ship/Shore/Ship Buffer
STANAG 5620	Standards for the Interoperability of ADP Fire Support Systems
STANAG 5621	Standards for the Interoperability of NATO Land Combat and Combined Operations Systems
STANAG 5622	Air Operations System
STANAG 5623	Standards for Interoperability of Maritime Operations Systems

C. OTHER NATO DOCUMENTS

ACP 127	Message Relay Procedures
ACP 167(F)	Glossary of Communications-Electronics Terms, NATO, August 1981, UNCLASSIFIED
ADatP-2(D)	NATO Glossary of Automatic Data Processing (ADP) Terms and Definitions, December 1985, NATO UNCLASSIFIED
ADatP-3 (STANAG 5500)	NATO Message Text Formatting Systems, Part IV, Catalog of Standard Field Formats, December 1986, NATO UNCLASSIFIED
AM 96-1-4	Data Management, SHAPE, 30 October 1988, NATO UNCLASSIFIED
Classification Guide	NATO Network Security Information Classification Guide (NU), Version 1.0, TSGCEE SG9, February 1989, NATO RESTRICTED
MC[1] 203/2	The Operational Requirements for the Interoperability of the Communications Between Different National Component Land Forces in the Combat Zone and the Communication Used in Provision of Air and Naval Support to These Forces
MC 277	The Operational Requirements for the Interoperability of Tactical Communication Systems for Use by the NATO Nations in the Land Combat Zone - Post 1985
MC 283	The Military Police for ECCM Applied to Tactical Communications in the Combat Zone
MC 284	The NATO Military Requirement for ECM Resistant and Secure Communications (NR)
NIMP	NATO Interoperability Management Plan (NIMP), Third Endorsement Edition, ADSIA-RCU-D/1 (Revised), Allied Data Systems Interoperability Agency, 1 July 1988, NATO UNCLASSIFIED
NIPD Vol. 1	NATO Interoperability Planning Document (NIPD), Volume 1, Introduction to Information Systems Interoperability Including the Allied Data Systems Interoperability Agency and the Organization of and Coordination Among NATO

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1 MC: Military Characteristic

Bodies Involved in NATO Common Interoperability Standards Development and Configuration Management, Second Draft, ADSIA-RCA-WP/76, 20 April 1990, NATO UNCLASSIFIED

NIPD Vol. 2 — NATO Interoperability Planning Document (NIPD), Volume 2, Formal Specification of Information Exchange Requirements, Draft, ADSIA-RCA-WP/72, February 1990, NATO UNCLASSIFIED

NIPD Vol. 3 — NATO Interoperability Planning Document (NIPD), Volume 3, Plan for Development of NATO Common Interoperability Standards (NCIS), Revised Draft, ADSIA-RCA-WP/73 (First Revise), February 1990, NATO UNCLASSIFIED

NIPD Vol. 4 — NATO Interoperability Planning Document (NIPD), Volume 4, NATO Common Interoperability Standards Configuration Management Plan (NCISCMP), Revised Draft, ADSIA-RCA-WP/32 (5th Revise), August 1989, NATO UNCLASSIFIED

NIPD Vol. 5 — NATO Interoperability Planning Document (NIPD), Volume 5, NATO Common Interoperability Standards Testing Concept, First Draft, ADSIA-RCA-WP/75, February 1990, NATO UNCLASSIFIED

NIPD Vol. 6 — NATO Interoperability Planning Document (NIPD), Volume 6, Documentation Plan for NATO Common Interoperability Standards, First Draft, ADSIA-RCA-D-15-90, 13 June 1990, NATO UNCLASSIFIED

NOSA — NATO OSI Security Architecture (NOSA), Ad Hoc Working Group on Security, TSGCEE SG9, Draft Version 2.1, March 1988, NATO UNCLASSIFIED

NTIS Transition Strategy — NATO Technical Interface Standards (NTIS) Transition Strategy, Fifth Edition, AC/259-D/1218(Revised), Conference of National Armaments Directors (CNAD), Tri-Service Group on Communications and Electronic Equipment (TSGCEE), NATO, Brussels, 30 November 1989, NATO UNCLASSIFIED

SANISI — Security Architecture for NATO Information Systems Interconnection (SANISI) (NU), Version 2.0, Ad Hoc Working Group on Security, TSGCEE SG9, AC/302(SG/9)D/53, 14 April 1989, NATO CONFIDENTIAL

STAMINA 4.0 — Standard Automated Message Interface for NATO ACCIS (STAMINA), Version 4.0, NACISA, April 1990, NATO UNCLASSIFIED

TM-776 — Data Management Standardisation for ACE ACCIS, TM-776, SHAPE Technical Centre, July 1985, NATO UNCLASSIFIED.

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II. U.S. MILITARY STANDARDS

DoD-STD-1467	Software Support Environment, 18 January 1985
DoD-STD-1700	Data Management Program, 28 September 1987
DoD-STD-1703	Software Product Standards, 12 February 1987
DoD-STD-1838	Common Ada Programming Support Environment (APSE) Interface Set (CAIS), 9 October 1987
DoD-STD-2167A	Defense System Software Development
MIL-A-89007	Presentation Manager
MIL-C-28748A	Connectors, Electrical, Rectangular, Rack and Panel, Solder-Type and Crimp-Type Contacts, February 1985
MIL-D-28000	Digital Representation for Communication of Product Data: IGES Application Subsets, 22 December 1987 with Amendment 1 of 20 December 1988 (used in CALS for computer-aided design and vector graphics (e.g., in technical manual illustrations, engineering diagrams)
MIL-D-28003	Digital Representation for Communication of Illustration Data: CGM Application Profile, 20 December 1988 (based on CGM; used in CALS for vector graphics in technical manual illustrations)
MIL-D-89000	Digital Terrain Elevation Data
MIL-HDBK-59	CALS Program Implementation Guide, 20 December 1988
MIL-HDBK-782	Software Support Environment Acquisition Implementation Guide for DoD-STD-2167, 29 February 1988
MIL-M-28001	Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text and Amendment 1, 1988 (based on ISO 8879, SGML)
MIL-R-28002	Requirements for Raster Graphics Representation in Binary Format, 20 December 1988 (based on GRP 4 Raster de facto industrial standards; used in CALS for raster-scanned images in engineering drawings and technical manual illustrations)
MIL-STD-188-114A	Electrical Characteristics of Digital Interface Circuits, July 1984
MIL-STD-188C	Military Communication System Technical Standards, November 1969
MIL-STD-188-100	Common Long-Haul and Tactical Communication System Technical Standards, November 1972
MIL-STD-188-148(S)	Interoperability Standards for Anti-Jam Communications in the HF Band (U)
MIL-STD-1388-2B	DoD Requirements for a Logistic Support Analysis Record
MIL-STD-1777	Internet Protocol (IP), August 1983
MIL-STD-1778	Transmission Control Protocol (TCP), August 1983
MIL-STD-1779	Interfaces for High Capacity C3 Local Area Networks, November 1983
MIL-STD-1780	File Transfer Protocol (FTP), May 1984
MIL-STD-1781	Simple Mail Transfer Protocol (SMTP), May 1984
MIL-STD-1782	TELENET Protocol, May 1984
MIL-STD-1840A	Automated Interchange of Technical Information, 1987
MIL-STD-1815A	Ada Programming Language (ISO 8652)
MIL-STD-1840A	Automated Interchange of Technical Information, 22 December 1987 with Change Notice 1 of 20 December 1988

RFC 742	Finger Protocol
RFC 768	User Datagram Protocol (UDP)
RFC 783	Trivial File Transfer Protocol (TFTP)
RFC 792	Internet Control Message Protocol ICMP)
RFC 822	Format of Electronic Mail Messages
RFC 826	Address Resolution Protocol (ARP)
RFC 862	Echo Protocol
RFC 863	Discard Protocol
RFC 864	Character Generator Protocol
RFC 866	Active Users Protocol
RFC 867	Daytime Protocol
RFC 868	Time Server Protocol
RFC 877	Internet Protocol on X.25 Networks
RFC 891	Internet Protocol on DC Networks
RFC 894	Internet Protocol on Ethernet Networks
RFC 903	A Reverse Address Resolution Protocol (RARP)
RFC 904	Exterior Gateway Protocol (EGP)
RFC 907	Internet Protocol on Wideband Networks
RFC 919	Internet Protocol Broadcast Datagrams
RFC 922	Internet Protocol Broadcast Datagrams With Subnets
RFC 950	Internet Protocol Subnet Extension
RFC 951	Bootstrap Protocol (BOOTP)
RFC 954	Whols Protocol
RFC 1001-1002	NetBIOS Service Protocol
RFC 1009	Gateway Requirements
RFC 1010	Assigned Numbers
RFC 1034-1035	Domain Name System
RFC 1042	Internet Protocol on IEEE 802
RFC 1044	Internet Protocol on Hyperchannel Networks
RFC 1048	Bootstrap Protocol (BOOTP)
RFC 1054	Internet Group Multicast Protocol (IGMP)
RFC 1055	Transmission of IP Over Serial Lines
RFC 1058	Routing Information Protocol (RIP)
RFC 1059	Network Time Protocol
RFC 1065	Structure of Management Information (SMI)
RFC 1066	Management Information Base (MIB)
RFC 1084	Bootstrap Protocol (BOOTP)
RFC 1088	Transmission of IP Over NetBIOS
RFC 1095	Common Management Information Services and Protocol Over TCP/IP (CMOT)
RFC 1098	Simple Network Management Protocol (SNMP)
RFC xxxx	Requirements for Internet Hosts - Communications Layer
RFC xxxx	Requirements for Internet Hosts - Application Layer

III. AGREEMENTS FROM REGIONAL WORKSHOPS

EWOS xxxx	EWOS Technical Guide on Lower Layer Relays, Final Draft, EWOS, 1990
EWOS/ETG003	EWOS/EG FT, File Transfer Access and Management - FTAM Remote Actions (RA) Service and Protocol, 24 January 1990
EWOS/EG VT/89	Application Function A/4121, Basic Class VT S-Mode Forms Functional Standard, Part 1: Virtual Terminal Service, EWOS/EG VT/89/53, Part 2: VT Protocol Check List, EWOS/EG VT/89/59, and Part 3: Underlying Layers Check List, EWOS/EG VT/89/60, Final Text, prENV 41 208
Profile RC p,q	X.25 Protocol Relaying, Draft, EWOS/EGLL/2990/81, EWOS, 9 May 1990
ECMA TR/46	Security in Open Systems--A Security Framework, ECMA TR/46, European Computer Manufacturers Association, July 1988
NIST SP 500-177	Stable Implementation Agreements for Open Systems Interconnection Protocol, Version 3, Edition 1, Proceedings of the December 1989 NIST OSI Implementor's Workshop (NOIW), March 1990
NISTIR 88-4017	Standards for the Interchange of Large Format Tiled Raster Documents, U.S. NIST, December 1988
ENV[2] 41 101♦	LANs: Provision of the OSI Connection-Mode Transport Service (COTS) Service Using the Connectionless-Mode Network Service (CLNS) on a CSMA/CD Single LAN, June 1986
ENV 41 102♦	LANs: Provision of the OSI COTS and the CLNS on a CSMA/CD Single or Multiple LAN Configuration, June 1986
ENV 41 103♦	LANs: Provision of the OSI COTS and the Connection-Mode Network Service (CONS) in an End System on a CSMA/CD LAN, December 1987
ENV 41 104	Packet Switched Data Networks: Permanent Access, August 1987
ENV 41 105♦	Packet Switched Data Networks: Switched Access, June 1988
ENV 41 106♦	Digital Data Circuit (CSDN) - Provision of the OSI COTS in the T.70 Case for Telematic End Systems, June 1988
ENV 41 107♦	Digital Data Circuit (CSDN) - Provision of the OSI COTS and the OSI CONS, June 1988
ENV 41 108♦	LANs: Provision of the OSI COTS and CONS in an End System on a Token Ring LAN, May 1988
ENV 41 109♦	LANs: Provision of the OSI COTS Using CLNS on a Token Ring Single LAN, February 1988
ENV 41 110♦	LANs: Provision of the OSI COTS Using CLNS in an End System on a Token Ring LAN in a Single or Multiple LAN Configuration, February 1988
ENV 41 201	Private Message Handling System - User Agent and Message Transfer Agent; Private Management Domain to Private Management Domain, June 1986

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2 ENV indicates a standard approved by the Join European Standards Institution (CEN/CENELEC) and the European Workshop for Open Systems (EWOS).

ENV 41 202	Message Handling Systems; User Agent and Message Transfer Agent: Access to an Administration Management Domain (ADMD), August 1987
ENV 41 203	Exchange of Telex Documents Between Two End Systems, Which May Be Teletex Terminals, June 1988
ENV 41 204◆	FTAM: Simple File Transfer, June 1988
ENV 41 205◆	FTAM: File Management, June 1987
ENV 41 901	X.29-Mode Procedures Between a Packet Mode DTE or a PAD and a PAD via a Public or Private X.25 Packet Switched Network or ISO 8208 Packet Level Entity and ISO 7776 Link Level Entity, June 1987
M-IT-02	Directory of Functional Standards (For Interworking in an OSI Environment) Adopted by the CEN/CENELEC/CEPT/ITSTC, March 1987

Proposed NIST OIW ISP on Directory [SGFS N 216, 11 June 1990]:

Part 1: [Title to be taken from FTAM ISP, adding ROSE]

Part 2: ADI 11, Directory User Agent (DUA) Basic Operation

Part 3: ADI 12, DUA Secure Operation

Part 4: ADI 13, DUA Operation in Distributed Environment

Part 5: ADI 211, Directory Service Agent (DSA) - DUA Basic Operation Interaction

Part 6: ADI 212, DSA - DUA Secure Operation Interaction

Part 7: ADI 221, DSA - DSA Basic Operation Interaction

Part 8: ADI 222, DSA - DSA Secure Operation Interaction

Part 9: ADI 131, Common Use Directory Information

Part 10: ADI 132, Strong Authentication Directory Information

IV. U.K. BSI STANDARDS AND PAPERS

IST/21: 1914	Delegates Report of the ISO/IEC JTC1 SC21/WG4 Plenary, OSI Management and Directory Services, Florence, 31 October to 9 November 1989
IST/21:2160	Report on SC21 Plenary, Held in Seoul, BSI IST/21, 5-6 June 1990, 13 July 1990
IST/21:2161	Report of SC21/WG1 Meeting, Seoul, Korea, 23-31 May 1990, BSI, IST 21, 27 July 1990
IST/21:2162	Report of SC21/WG3 Database Meeting, Seoul, Korea, 21 May to 1 June 1990, BSI, IST 21, 27 July 1990
IST/21:2164	OSI Specific Applications Services, ISO/IEC JTC1/SC21 WG5 Meeting, Seoul, Korea, 24 May to 1 June 1990, BSI, IST 21, 10 July 1990
IST/21:2165	Report of Seventh Meeting of SC21/WG6, Seoul, Korea, 23 May to 1 June 1990, BSI, IST 21, 3 August 1990
IST/21:2170	JTC1 Workshop on Security, London, 5-7 November 1990, BSI IST21, 29 June 1990
IST/21:2187	IST/21 Activities 1989-1990, 27 July 1990
IST/21:2236	Report of SC21/WG1/FDT Meeting, Seoul, Korea, 23 May to 31 May 1990, BSI, IST 21, 30 July 1990
IST/21:2237	Security Liaison Requirements, 27 July 1990
IST/21:2249	Current and Recent Ballots, 10 August 1990
U.K. GOSIP Vol. 1	U.K. Government OSI Profile, Volume I, Introduction, Version 3.1, Central Computer and Telecommunications Agency, London, 1990
U.K. GOSIP Vol. 2	U.K. Government OSI Profile, Volume II, Specification, Version 3.1, Central Computer and Telecommunications Agency, London, 1990
U.K. GOSIP Vol. 3	U.K. Government OSI Profile, Volume III, Procurement Handbook, Version 3.1, Central Computer and Telecommunications Agency, London, 1990
Users Handbook	Users' Open Systems Handbook, Level-7 Limited, United Kingdom, 1989

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V. US STANDARDS AND PAPERS

ANSI X3.1	Information Systems - Data Transmission - Synchronous Signalling Rates, 1987 (FIPS 22-1)
ANSI X3.4	Coded Character Sets - 7-Bit American National Standard Code for Information Exchange (7-Bit ASCII), 1986
ANSI X3.9	Programming Language FORTRAN, 1978 (revised 1989) (ISO 1539)
ANSI X3.15	Bit Sequencing of the American National Standard Code for Information Exchange in Serial-By-Bit Data Transmission, 1976 (FIPS 16-1)
ANSI X3.23	Programming Language COBOL, 1985 (ISO 1989)
ANSI X3.23A	Addendum to ANSI X3.23-1985, Programming Language COBOL, 1989
ANSI X3.32	Graphic Representation of the Control Characters of American Standard Code for Information Exchange, 1973
ANSI X3.41	Code Extension Techniques for Use with the 7-Bit Coded Character Set of American National Standard Code for Information Exchange, 1974 (FIPS 35, WITHDRAWN)
ANSI X3.53	Programming Language PL/1, 1976 (ISO 6160)
ANSI X3.42	Representation of Numeric Values in Character Strings for Information Interchange, 1975
ANSI X3.66	Advanced Data Communication Control Procedures (ADCCP), 1979 (FIPS 71)
ANSI X3.74	Programming Language PL/1 General Purpose Subset, 1981 (ISO 6522)
ANSI X3.83	Sponsorship Procedures for ISO Registration According to ISO 2375, November 1988
ANSI X3.91M	Interfaces, Storage Module, 1987
ANSI X3.92	Data Encryption Algorithm, 1981
ANSI X3.97	Programming Language Pascal, 1983 (ISO 7185)
ANSI X3.98	Text Information Interchange in Page Image Format (PIF), 1983
ANSI X3.102	Data Communication Systems and Services User Oriented Performance Parameters, 1985
ANSI X3.105	Information Systems - Data Link Encryption, 1983
ANSI X3.106	Information Systems - Data Encryption Algorithm - Modes of Operation, 1983
ANSI X3.107	Data Link Layer Protocol for Local Distributed Data Interfaces (LDDI), August 1982 (DP)
ANSI X3.108	Information Systems - Local Distributed Data Interfaces (LDDI) - Physical Layer Interface to Nonbranching Coaxial Cable Bus, 1988
ANSI X3.109	Physical Layer Protocol for Local Distributed Data Interfaces (LDDI), 1982 (DP)
ANSI X3.110	Videotex/Teletext Presentation Level Protocol (North American PLPS), 1983
ANSI X3.113	Full BASIC, 1987 (FIPS 68-2)
ANSI X3.113A	Addendum to Programming Language Full BASIC, Modules and Individual Character Input
ANSI X3.122	Computer Graphics Metafile (CGM) for the Storage and Transfer of Picture Description Information, 1986 (ISO 8632)
ANSI X3.122.5	LIST Binding of GKS, Draft, 1989
ANSI X3.123	Programming Language APL, Draft, 1989 (DP 8485)

ANSI X3.124	Computer Graphics - Graphical Kernel System (GKS) Functional Description, 1985 (ISO 7942)
ANSI X3.124.1	Computer Graphics - Graphical Kernel System (GKS) FORTRAN Language Binding, 1985 (ISO 8651-1)
ANSI X3.124.2	Computer Graphics - Graphical Kernel System (GKS) Pascal Language Binding, 1988 (ISO 8651-2)
ANSI X3.124.3	Computer Graphics - Graphical Kernel System (GKS) C Language Binding, 1989 (ISO 8651-3)
ANSI X3.124.4	Computer Graphics - Graphical Kernel System (GKS) FORTRAN Binding, Draft, 1989 (DP 8651-4)
ANSI X3.129	Intelligent Peripheral Interface, Physical Level, 1986
ANSI X3.130	Intelligent Peripheral Interface - Device-Specific Command Set for Magnetic Disks, 1986
ANSI X3.131	Small Computer System Interface (SCSI), 1986
ANSI X3.132	Intelligent Peripheral Interface - Device Generic Command Set for Magnetic and Optical Disks, 1987
ANSI X3.133	Database Language NDL, 1986 (FIPS 126)
ANSI X3.134.1	8-Bit ASCII Structure and Rules, 1986
ANSI X3.134.2	7-Bit and 8-Bit ASCII Supplemental Multilingual Graphic Character Set (ASCII Multilingual Set), 1986 (DP)
ANSI X3.135	Database Language SQL, 1986 (FIPS 127) [relational database application program interface] (ISO 9075)
ANSI X3.135.1	Database Language SQL - Addendum 1: Integrity Enhancement Feature, 1988 (DP)
ANSI X3.138	Information Resource Dictionary System (IRDS), 1988 (DIS 10027)
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ANSI X3.140	Information Processing Systems - Open Systems Interconnection - Connection Oriented Transport Layer Protocol Specification, 1986 (ISO 8072 and 8073)
ANSI X3.141	Data Communication Systems and Services - Measurement Methods for User-Oriented Performance Evaluation, 1987
ANSI X3.143	Information Processing Systems - Text and Office Systems - Standard Generalized Markup Language (SGML), 1985 (DP)
ANSI X3.144	Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) Functional Description, September 1988 (ISO 9592, 9593)
ANSI X3.144.1	ANS for the FORTRAN Language Binding of the Programmer's Hierarchical Interactive Graphics System (PHIGS) Binding to FORTRAN, Draft, 1986 (DIS 9593-1)
ANSI X3.144.2	Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) Binding to Pascal, Draft, 1987 (DP 9593-2)
ANSI X3.144.3	Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) Binding to Ada, Draft, 1987
ANSI X3.144.4	Computer Graphics - Programmer's Hierarchical Interactive Graphics System (PHIGS) C Language Binding, Draft, September 1988 (DP 9593-4)
ANSI X3.146	Streaming Cartridge and Cassette Tape Drives - Device-Level Interface, 1987
ANSI X3.147	Intelligent Peripheral Interface - Device Generic Command Set for Magnetic Tape, 1987
ANSI X3.148	Fibre Distributed Data Interface (FDDI) - Physical Layer Protocol (PHY), 1988 (DIS 9314-1)

ANSI X3.153	Open Systems Interconnection - Basic Connection Oriented Session Protocol Specification, 1987 (ISO 8327)
ANSI X3.159	Information Systems - Languages - Programming Language C, 1988 (DP)
ANSI X3.160	Programming Language Extended Pascal, 1988 (DP)
ANSI X3.161	Computer Graphics Interface (CGI), Draft, 1989 (ISO 9636)
ANSI X3.166	Fibre Distributed Data Interface (FDDI) - Physical Layer Medium Dependent (PMD), October 1988 (DP)
ANSI X3.167	Local Distributed Data Interface (LDDI) Star-Wired Physical Interface Sublayer, 1987 (DP)
ANSI X3.168	Information Systems - Language - Embedding of SQL Statements into Programming Languages, 1988 (DP)
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ANSI X3.172	American National Standard Dictionary for Information Systems, August 1988 (DP)
ANSI X3.176	Intelligent Peripheral Interface - Logical Device-Specific Command Set for Magnetic Tapes, November 1988 (DP)
ANSI X3.177	Intelligent Peripheral Interface - Device Generic Command Set for Communications, November 1988 (DP)
ANSI X3.194	Database Language SQL2, Draft
ANSI X12	Electronic Data Interchange (ISO 9735)
IEEE 770	Programming Language Pascal, 1983
IEEE P1003.0	Guide to POSIX-based Open System Architecture, Draft
IEEE P1074	Software Life Cycle Processes, Draft
IEEE P1172	Object Oriented Programming Language and Environment, Draft
IEEE P1178	SCHEME Language Standard, Draft
IEEE P1201	Window Interface for User Application and Portability, Draft
IEEE P1209	Recommended Practice for Evaluation of CASE Tools, Draft
FIPS 146	Government Open Systems Interconnection Profile (GOSIP), FIPS 146,Version 1.0, U.S. National Institute of Standards and Technology, 15 August 1988
Stable Agreements	Stable Implementation Agreements for Open Systems Interconnection Protocols, Version 2, Edition 1, NIST Special Publication 500-16, National Institute of Standards and Technology, December 1988 (basis for U.S. GOSIP 1.0)
Stable Agreements	Stable Implementation Agreements for Open Systems Interconnection Protocols, Version 3, Edition 1, NIST Special Publication 500-177, National Institute of Standards and Technology, March 1990 (Proceedings of December 1989 NIST OSI Implementor's Workshop; basis for U.S. GOSIP 2.0)
Working Agreements	Working Implementation Agreements for Open Systems Interconnection Protocols: Continuing Agreements, Volume 2, Number 2, NISTIR 90-4247, National Institute of Standards and Technology, February 1990 (Proceedings of December 1989 NIST OSI Implementor's Workshop)
Yellow Book	Computer Security Requirements--Guidance for Applying the Department of Defense Trusted Computer System Evaluation Criteria in Specific Environments (Yellow Book), CSC-STD-003-85, DoD Computer Security Center, June 1985

Yellow Book Rationale — Technical Rationale Behind CSC-STD-003-85: Computer Security Requirements--Guidance for Applying the Department of Defense Trusted Computer System Evaluation Criteria in Specific Environments, CSC-STD-004-85, DoD Computer Security Center, June 1985

Orange Book — Department of Defense Trusted Computer System Evaluation Criteria (Orange Book), DoD 5200.28-STD, DoD Computer Security Center, December 1985

Red Book — Trusted Network Interpretation (Red Book), NCSG-TG-005, Version 1, National Computer Security Center, July 1987

SDN.301 — Secure Data Network System (SDNS) Security Protocol 3 (SP3), Revision 1.5, SDNS Protocol and Signalling Working Group, 15 May 1989, National Security Agency, UNCLASSIFIED

SDN.401 — Secure Data Network System (SDNS) Security Protocol 4 (SP4), Revision 1.3, SDNS Protocol and Signalling Working Group, 2 May 1989, National Security Agency, UNCLASSIFIED

SDN.601 — Secure Data Network System (SDNS) Key Management Profile, Communication Protocol Requirements for Support of the SDNS Key Management Protocol, Revision 1.5, SDNS Protocol and Signalling Working Group, 11 August 1989, National Security Agency, UNCLASSIFIED

SDN.701 — Secure Data Network System (SDNS) Message Security Protocol (MSP), Revision 1.5, SDNS Protocol and Signalling Working Group, 1 August 1989, National Security Agency, UNCLASSIFIED

SDN.702 — Secure Data Network System (SDNS) Directory Specifications for Utilization with the SDNS Message Security Protocol (MSP), Revision 1.4, SDNS Protocol and Signalling Working Group, 1 August 1989, National Security Agency, UNCLASSIFIED

SDN.801 — Secure Data Network System (SDNS) Access Control Concept Document, Revision 1.3, SDNS Protocol and Signalling Working Group, 26 July 1989, National Security Agency, UNCLASSIFIED

SDN.802 — Secure Data Network System (SDNS) Access Control Specification, Revision 1.0, SDNS Protocol and Signalling Working Group, 25 July 1989, National Security Agency, UNCLASSIFIED

SDN.802/1 — Secure Data Network System (SDNS) Access Control Specification, Addendum 1, Access Control Information Specification (ACIS), Revision 1.0, SDNS Protocol and Signalling Working Group, 25 July 1989, National Security Agency, UNCLASSIFIED

SDN 902 — Secure Data Network System (SDNS) Key Management Protocol, Definition of Services Provided by the Key Management Application Service Element (KMASE), Revision 3.2, SDNS Protocol and Signalling Working Group, 1 August 1989, National Security Agency, UNCLASSIFIED

SDN 903 — Secure Data Network System (SDNS) Key Management Protocol, Specification of the Protocol for Services Provided by the Key Management Application Service Element (KMASE), Revision 3.2, SDNS Protocol and Signalling Working Group, 1 August 1989, National Security Agency, UNCLASSIFIED

SDN 906 — Secure Data Network System (SDNS) Key Management Protocol, SDNS Traffic Key Attribute Negotiation, Revision 1.3b, SDNS Protocol and Signalling Working Group, 18 September 1989, National Security Agency, UNCLASSIFIED

APPENDIX I

BACKGROUND, OBJECTIVE, AND STATEMENT OF WORK

APPENDIX I

BACKGROUND, OBJECTIVE, AND STATEMENT OF WORK

(U) This IDA Document was written in response to Task Order T-J1-246 and Amendment No. 8. Those portions of the task order that pertain to the background and objectives of the task, and the additional guidance provided therein by the sponsoring office, are reprinted here.

2. BACKGROUND:

The tactical ADP portion of the NATO Long Term Defense Program (LDTP) proposed that command and control systems be built to common specifications. The Deputy SACEUR initiated a study to determine the feasibility of the nations in the Central Region commonly developing an Automated Army Tactical Command and Control Information System (ATCCIS) for deployment in the post-1955 timeframe. Commitments for supporting this effort were obtained from US, UK, and FRG Army Chiefs of Staff. These nations provided information on their operational doctrine, procedures, functions, and information exchange requirements for their maneuver forces, as well as their operational requirements for an automated CCIS and information on the ADP systems that they are currently developing to support their maneuver forces. This information was used in the initial phase of the study to determine the extent to which similarities and differences in national requirements for automated CCISs would indicate that a commonly developed system is potentially feasible. The results of this initial phase were positive. SHAPE has requested that the nations complete the study and has received US, UK, FR and FRG Army Chiefs of Staff commitments.

3. OBJECTIVE:

The objective of this phase II effort of the study is to assist SHAPE in defining the military objectives and basic operational requirements for a common ATCCIS that achieves interoperability to ADP systems. The capabilities of ADP systems are to be compared to the concept of operations

of each of the nations to determine the extent to which such a common ATCCIS could accommodate the requirements of each of the nations and to identify issues remaining to be resolved before such a system could be employed in the Central Region in post-1995 time period.

4. STATEMENT OF WORK:

The FY 1990 task includes:

f. Perform additional analysis, as appropriate, and address specific topics identified as a result of the NATO TSGCEE review of draft edition 1.2, Architectural Standards (Working Paper 25).

APPENDIX J

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REFERENCES

1. ATCCIS Working Paper 22, "Architectural Concepts," Edition 3, 25 September 1987, NATO UNCLASSIFIED.
2. ATCCIS Working Paper 23, "Requirements Analysis," Edition 1, 16 September 1987, NATO UNCLASSIFIED.
3. ATCCIS Working Paper 24, "Architecture Definition," Edition 2, 24 October 1988, NATO UNCLASSIFIED.
4. *NATO Technical Interface Standards (NTIS) Transition Strategy,* Fifth Edition, AC/259-D/1218(Revised), Conference of National Armaments Directors (CNAD), Tri-Service Group on Communications and Electronic Equipment (TSGCEE), NATO, Brussels, 30 September 1989, NATO UNCLASSIFIED.
5. *Draft Compilation of OSI Standards,* M. J. Purton, Unpublished, August 1987.
6. *Computer Communications: Architecture, Protocols and Standards*, William Stallings, IEEE Computer Society Press, Silver Spring, Maryland, 1985.
7. *Handbook of Computer-Communications Standards*, 3 Volumes, William Stallings, MacMillan Publishing Company, New York, 1987.
8. *Issues Within the NATO Military Data Communications Internetwork,* Draft Working Paper, TSGCEE SG9, 1 September 1987, NATO UNCLASSIFIED.
9. *Handbook of Computer-Communications Standards,* William Stallings, Volume 1: *The Open Systems Interconnection (ISO) Model and OSI-Related Standards,* MacMillan Publishing Company, New York, 1987.
10. *User Requirements for Multi-Party Communications (MPC),* SC21 N 4681, Canada, May 1990.
11. *Liaison Statement of SC21/WG1 on Update of the OSI Reference Model,* SC21 N 4546, CCITT SG VII, March 1990.
12. *Final Answer to Q1/330.6 on Relay, Routing, and Network Management,* SC21 N 5074, SC21/WG1, May 1990.
13. *Liaison to SC6 on Revision of the Reference Model,* SC21 N 5095, May 1990.
14. *Liaison to CCITT SG VII on Revision of the Reference Model,* SC21 N 5096, June 1990.
15. *Draft Answer to Q1/61 on Consistency Among ISO Standards Related to the OSI Reference Model,* SC21 N 5081, May 1990.
16. *Liaison Statement to CCITT SG VII(Q.25) on Service Conventions,* SC21 N 5099, SC21/WG1, May 1990.
17. *Liaison Statement of SC21 on OSI Reference Model Update Effort,* SC21 N 4559, CCITT SG VII, March 1990.

18. *Second Working Draft for Amendment 1 to ISO 9545 ALS on Extended Application Layer Structure,* SC21 N 4901, SC21/WG6, June 1990.

19. *Extended Application Layer Structure, ANSI Contribution to SC21/WG6,* SC21 N 4002, 19 October 1989.

20. *Clarification of ALS Modelling Concepts, Workshop on Distributed Applications,* SC21 N 4519, 18 April 1990.

21. *Request for Comment on Introduction of a New Relationship in ALS,* SC21 N 4905, SC21/WG6, June 1990.

22. *Disposition of Ballot Comments in JTC1 N 764 on the Proposal for a NWI--Extension to ISO 9545 ALS for Application Layer Recovery Model,* SC21 N 4910, SC21/WG6, June 1990

23. *Modelling Recovery in the Application Layer,* SC21 N 5011, SC21/WG6, 1 June 1990

24. *Disposition of Ballot Comments in JTC1 N 846 on the Proposal for a NWI--Extension to ISO 9545 ALS for Multi-Level Structures,* SC21 N 4909, SC21/WG6, June 1990

25. *Notes on IST21 Ad Hoc Meeting on Distributed Applications,* IST/21:1721, British Standards Institute IST21, 25 July 1989.

26. *Issues for Consideration by Joint ULA/ODP Meeting, Seoul, May/June 1990,* SC21 N 4520, Workshop on Distributed Applications, 18 April 1990.

27. *Modelling for Communications Aspects of Distributed Applications,* SC21 N 4911, SC21/WG6, May 1990.

28. *Topics Proposed for Discussion at the JTC1 Workshop on Distributed Applications, Phoenix, March 1990,* SC21 N 4354, UK Contribution, January 1990.

29. *Time Critical Communication Architecture: A Current Work Item Within Industrial Automation Systems (TC184) of ISO,* M. Kirk, ERA Technology Limited, UK, Military OSI Symposium Proceedings, SHAPE Technical Centre, 6-8 June 1990, NATO UNCLASSIFIED.

30. *The Open Book - A Practical Perspective on OSI,* M. T. Rose, Prentice Hall, Englewood Cliffs, New Jersey, 1990.

31. *Stable Implementation Agreements for Open Systems Interconnection Protocols,* Version 2, Edition 1, NIST Special Publication 500-16, US National Institute of Standards and Technology, December 1988, UNCLASSIFIED.

32. *Ongoing Implementation Agreements for Open Systems Interconnection Protocols: Continuing Agreements,* NISTIR 88-3824-2, National Institute of Standards and Technology, February 1989, UNCLASSIFIED.

33. *The X.400 Blue Book Comparison,* Carl-Uno Manvos, Technology Appraisals, London, 1989.

34. Private communications with three members of the NIST X.400 Special Interest Group, 25 May-14 June 1989, UNCLASSIFIED.

35. "X.400 1988 and X.500 (The Directory) Make Their Debut," *OSN: The Open Systems Newsletter,* Volume 2, Issue 8, Technology Appraisals, Limited, London, October 1988, UNCLASSIFIED.

36. *Proposed FTAM Document Type to Support CGM,* SC21 N 4192, SC21/WG5, December 1989.

37. *EWOS/EG FT, File Transfer Access and Management - FTAM Remote Actions (RA), Service and Protocol,* EWOS/ETG003, January 1990.

38. *OSN: The Open Systems Newsletter,* Volume 4, Issue 3, March 1990, pp. 14-18.

39. *Report of Joint ISO/IEC JTC1 SC21/WG4 and CCITT SG VIII(Q20) Meeting on Enhancements to the Directory,* Geneva, February 5th to 14th 1990, IST/21:2041, British Standards Institute IST21, 19 March 1990.

40. *Proposed DIT Structure Rule Definition,* SC21 N 4804, 10 May 1990.

41. *Extensible Matching Rules (Revised),* SC21 N 4623, Canada, 3 May 1990.

42. *Use of External Data Transfer Systems for Shadow Updates,* SC21 N 4806, 10 May 1990.

43. *Letter for Information on Disposition of EDI Messaging Service (EDIMS) Use of Directory,* SC21 N 4799, 21 May 1990.

44. *Liaison Statement to SC21 on Joint Efforts Between SG VII(Q20) and SG I(Q16),* SC21 N 4801, CCITT SG I(Q.16), 21 May 1990.

45. *Meeting Minutes of the Florence Working Group Meeting on ODP,* SC21/WG7, SC21 N 4027, 11 December 1990.

46. *Liaison to CCITT SG VII(Q19) on OSI RPC,* SC21 N 4926, SC21/WG6, June 1990

47. *Remote Call Procedure Definitions and Requirements,* SC21 N 4928, SC21/WG6, June 1990

48. *US Response to SC21/WG6 N 7889 on Requirements for RPC Interface Definition Notation,* SC21 N 4767, 11 May 1990.

49. *OSN: The Open Systems Newsletter,* Volume 4, Issue 3, March 1990, pp. 9-11.

50. *OSN: The Open Systems Newsletter,* Volume 4, Issue 4, April 1990, p. 4.

51. *Liaison Statement to SC21/WG4/WG7 on Time Synchronization,* SC21 N 4565, CCITT SG VII, March 1990.

52. *Framework for OSI Management,* TR/37, European Computer Manufacturers Association, January 1987.

53. *US Army Transition Strategy,* 1989, UNCLASSIFIED.

54. *OSN: The Open Systems Newsletter,* Volume 4, Issue 4, April 1990, p. 10.

55. *Assigned Numbers,* J. K. Reynolds, Request for Comments (RFC) 1010, DDN Network Information Center, SRI International, May 1987.

56. Briefing to TSGCEE SG9 WG2 on ACP 127 and CCITT X.400 Service Element Comparison, US Principal Representative, January 1989, UNCLASSIFIED.

57. Briefing on POSIX, US National Institute of Standards and Technology, 12 June 1990, UNCLASSIFIED.

58. Briefing on POSIX and Applications Portability, Roger J. Martin, Institute for Computer Sciences and Technology, US National Institute of Standards and Technology, March 1990, UNCLASSIFIED.

59. *X/OPEN Portability Guide*, Volume 5, *Data Management*, X/OPEN Group, Amsterdam, January 1987.

60. *X/OPEN On-Line Transaction Processing Reference Model*, Discussion Paper, M. G. Lambert, ICL, United Kingdom, July 1987.

61. Briefing on X/OPEN, X/OPEN Group, Amsterdam, 2 March 1988.

62. Briefing on Applications Software Portability, Allen L. Hankinson, Institute for Computer Sciences and Technology, US National Institute of Standards and Technology, Gaithersburg, Maryland, 1988.

63. *Project Description for Project JTC1.21.30.2, Technical Report--Tutorial for Reference Model of Data Management*, IST/21 1534 (WG3 N 572), SC21/WG3, March 1988, UNCLASSIFIED.

64. *Database Management System Standards, Report of Past Progress and Future Prospects*, Donald R. Deutch, G.E. Information Services, US National Institute of Standards and Technology Symposium, 3 December 1987.

65. Discussions with Lynn Gallagher, Institute for Computer Sciences and Technology, US National Institute of Standards and Technology, Gaithersburg, Maryland, 24 May 1988.

66. *Remote Database Access: SQL Specialization*, SC21 N 2643, SC21/WG3, 9 May 1988, UNCLASSIFIED.

67. *Remote Database Access*, Tutorial, SC21 N 1927, SC21/WG3, 28 July 1987, UNCLASSIFIED.

68. *Information Processing Systems - Open Systems Interconnection - Remote Database Access: SQL Specialization, Service and Protocol*, SC 21 N 3342, SC21/WG3, 26 January 1989, UNCLASSIFIED.

69. *Proposal for Registration of Q3/007*, SC21 N 5146, SC21/WG3, 19 June 1990.

70. *OSN The Open Systems Newsletter*, Volume 4 Issue 1/Issue 2, January/February 1990, pp. 17-18.

71. *Draft WG3 Position on Conceptual Schema Question*, SC21 N 4195, February 1990.

72. *Concepts and Terminology for the Conceptual Schema and the Information Base*, TC97/SC5 N 695 and SC21 N 197, March 1982.

73. *Assessment Guideline for Conceptual Schema Language Proposals*, TC97/SC21/WG5-3, SC21 N 236, 31 August 1985.

74. *US Comments on Conceptual Schema*, SC21 N 4511, 15 March 1990.

75. *Proposal for Registration of Q3/001*, SC21 N 5140, SC21/WG3, 19 June 1990.

76. *Proposal for Registration of Q3/002*, SC21 N 5141, SC21/WG3, 19 June 1990.

77. *Metadata Use and Standards for Managing Metadata*, SC21 N 4593, ANSI, 4 April 1990.

78. *USA Position on the Progression of DIS 10026*, SC21 N 4759, 12 March 1990.

79. *Report on JTC1 SC21/WG5 OSI Transaction Processing Rapporteur Group Meeting. Florence, 1-9 November 1989*, A. J. Bainbridge, British Standards Institute, IST/21:1850, 14 November 1989.

80. *Request for Comments on Sub-Transactions*, SC21 N 4186, November 1989.

81. *OSI TP Security, New Work Item*, SC21 N 5176, SC21/WG5, June 1990.

82. *Queued Data Transfer for TP*, SC21 N 5184, SC21/WG5, May 1990.

83. *Unstructured Data Transfer (UDT) for OSI Transaction Processing*, SC21 N 5183, SC21/WG5, May 1990.

84. *OSI TP Association Management--Revised New Work Item*, SC21 N 5177, SC21/WG5, June 1990.

85. *OSI TP Association Management--Statement of Requirements*, SC21 N 5171, SC21/WG5, June 1990.

86. *Combined Use of RPC and OSI TP*, SC21 N 5172, SC21/WG5 and SC21/WG6, June 1990.

87. *ODP: Working Document on Topic 8.1--Draft Basic Reference Model of Open Distributed Processing*, SC21 N 4025, 11 December 1989.

88. *A Framework for Distributed Database Systems: Distribution Alternatives and Generic Architecture*, CODASYL, 1980.

89. *An Architectural Framework for Database Standardization*, Draft, ANSI DAFTG, 1982.

90. *Information Processing Systems - Open Systems Interconnection, Specification of Abstract Syntax Notation One (ASN.1)*, ISO/DIS 8824, 1986.

91. *Information Processing Systems - Open Systems Interconnection, Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*, ISO/DIS 8825, 1986.

92. *ECMA-DB Remote Database Access Service and Protocol*, Final Draft, European Computer Manufacturers Association, 1985.

93. *Government Open Systems Interconnection Profile (GOSIP)*, FIPS 146,Version 1, US National Institute of Standards and Technology, 15 August 1988.

94. Briefing on the Applications Portability Profile, Roger J. Martin, US National Institute of Standards and Technology, 16 May 1989, UNCLASSIFIED.

95. ATCCIS Working Paper 7L, *Data Management, Standardization, and Naming Conventions*, Edition 1.0, 2 June 1989, NATO UNCLASSIFIED.

96. Discussions with William Kenworthy, Chair, ISO JTC1/SC14, and Chair, ANSI X3L8, 28 December 1988, UNCLASSIFIED.

97. *Guide on Data Entity Naming Conventions*, NIST Special Publication 500-149, US National Institute of Standards and Technology, October 1987, UNCLASSIFIED.

98. *Army Data Management and Standards Program*, AR-25-9, Office of the Secretary of the Army, DISC4, July 1988.

99. *Data Management*, AC/317(WG/2)WP/60, NACISC, 5 June 1990.

100. *The Need for Standardisation of Data Management and Data Base Information Exchange in the NATO CCIS*, Enclosure 2 to ADSIA-RCA-WP/44 (Revised), ADSIA, September 1987, NATO UNCLASSIFIED.

101. *NATO Interoperability Management Plan (NIMP)*, Third Endorsement Edition, ADSIA-RCU-D/1 (Revised), Allied Data Systems Interoperability Agency, 1 July 1988, NATO UNCLASSIFIED.

102. ACE Manual 96-1-4, *Data Management*, SHAPE, 30 October 1988, NATO UNCLASSIFIED.

103. *Data Management Standardisation for ACE ACCIS*, TM-776, SHAPE Technical Centre, July 1985, NATO UNCLASSIFIED.

104. ADatP-2(D), *NATO Glossary of Automatic Data Processing (ADP) Terms and Definitions*, December 1985, NATO UNCLASSIFIED.

105. ADatP-3 (STANAG 5500), *NATO Message Text Formatting Systems*, Part IV, *Catalog of Standard Field Formats*, December 1986, NATO UNCLASSIFIED.

106. ACP 167(F), *Glossary of Communications-Electronics Terms*, NATO, August 1981, UNCLASSIFIED.

107. *Liaison Statement to JTC1 SC21 from JTC1 SWG-EDI*, JTC1 SWG-EDI, SC21 N 3925, 19 October 1989.

108. *Consideration of the Data Management Component of Application Standards*, SC21 N 4524, Workshop on Distributed Applications, 23 April 1990.

109. *Revised Report of the SC21 Strategic Planning Meeting*, SC21 N 3134, October 1988, UNCLASSIFIED.

110. *NATO OSI Security Architecture (NOSA)*, Ad Hoc Working Group on Security, TSGCEE SG9, Draft Version 2.1, March 1988, NATO UNCLASSIFIED.

111. *Security Architecture for NATO Information Systems Interconnection (SANISI) (NU)*, Version 2.0, Ad Hoc Working Group on Security, TSGCEE SG9, AC/302(SG/9)D/53, 14 April 1989, NATO CONFIDENTIAL.

112. Private communication with the Chair of the TSGCEE SG9 Ad Hoc Working Group on Security, 21 March 1989, UNCLASSIFIED.

113. *Application Layer Security Considerations*, SC21 N 4526, 18 April 1990.

114. *Request for National Body Comment on Security Enhancements to FTAM*, SC21 N 4184, SC21/WG5, November 1989.

115. *Liaison Statement from JTC1/SC18 to JTC1/SC21 on Changes to ASN.1*, SC21 N 4472, SC18/WG3 (title is in error--changes are for ODA, ISO 8613), 22 February 1990.

116. *Working Draft on Opens Systems Security Frameworks*, SC21 N 4210, December 1989.

117. *Minutes of the IST21 Ad Hoc Security Meeting Held at the BSI Conference Centre*, BSI IST21, 11 December 1989.

118. *Security Exchange Service Element*, SC21 N 3991, November 1989.

119. *Commencement of Work on Security ASEs*, SC21 N 5002, SC21/WG6, 31 May 1990.

120. *Security and Security Exchange Information*, Canadian contribution to SC21/WG6, SC21 N 4648, 28 February 1990.

121. *JTC1 Workshop on Security*, London, 5-7 November 1990, IST/21:2170, British Standards Institute IST21, 29 June 1990.

122. *NATO Network Security Information Classification Guide (NU)*, Version 1.0, TSGCEE SG9, February 1989, NATO RESTRICTED.

123. *Proceedings of the Military OSI Symposium*, Volume 3, June 1990, NATO SECRET.

124. *UK MOD Contribution to TSGCEE SG9/WG1*, 23 July 1990, NATO UNCLASSIFIED.

125. Briefing on Secure Data Network Systems (SDNS) to the Protocol Standards Steering Group, Gary Tater and Greg Bergren, National Security Agency, 25 October 1988, Record of the 35th Meeting of the PSSG, Defense Communications Engineering Center, 6 January 1989, UNCLASSIFIED.

126. *Secure Data Network System (SDNS) Security Protocol 3 (SP3)*, Specification SDN.301, Revision 1.5, SDNS Protocol and Signalling Working Group, 15 May 1989, National Security Agency, UNCLASSIFIED.

127. *Secure Data Network System (SDNS) Security Protocol 4 (SP4)*, Specification SDN.401, Revision 1.3, SDNS Protocol and Signalling Working Group, 2 May 1989, National Security Agency, UNCLASSIFIED.

128. *Secure Data Network System (SDNS) Key Management Profile, Communication Protocol Requirements for Support of the SDNS Key Management Protocol*, Specification SDN.601, Revision 1.5, SDNS Protocol and Signalling Working Group, 11 August 1989, National Security Agency, UNCLASSIFIED.

129. *Secure Data Network System (SDNS) Message Security Protocol (MSP)*, Specification SDN.701, Revision 1.5, SDNS Protocol and Signalling Working Group, 1 August 1989, National Security Agency, UNCLASSIFIED.

130. *Secure Data Network System (SDNS) Directory Specifications for Utilization with the SDNS Message Security Protocol (MSP)*, Specification SDN.702, Revision 1.4, SDNS Protocol and Signalling Working Group, 1 August 1989, National Security Agency, UNCLASSIFIED.

131. *Secure Data Network System (SDNS) Access Control Concept Document*, Specification SDN.801, Revision 1.3, SDNS Protocol and Signalling Working Group, 26 July 1989, National Security Agency, UNCLASSIFIED.

132. *Secure Data Network System (SDNS) Access Control Specification*, Specification SDN.802, Revision 1.0, SDNS Protocol and Signalling Working Group, 25 July 1989, National Security Agency, UNCLASSIFIED.

133. *Secure Data Network System (SDNS) Access Control Specification*, Addendum 1, *Access Control Information Specification (ACIS)*, Specification SDN.802/1, Revision 1.0, SDNS Protocol and Signalling Working Group, 25 July 1989, National Security Agency, UNCLASSIFIED.

134. *Secure Data Network System (SDNS) Key Management Protocol, Definition of Services Provided by the Key Management Application Service Element (KMASE)*, Specification SDN.902, Revision 3.2, SDNS Protocol and Signalling Working Group, 1 August 1989, National Security Agency, UNCLASSIFIED.

135. *Secure Data Network System (SDNS) Key Management Protocol, Specification of the Protocol for Services Provided by the Key Management Application Service Element (KMASE),* Specification SDN.903, Revision 3.2, SDNS Protocol and Signalling Working Group, 1 August 1989, National Security Agency, UNCLASSIFIED.

136. *Secure Data Network System (SDNS) Key Management Protocol, SDNS Traffic Key Attribute Negotiation,* Specification SDN.906, Revision 1.3b, SDNS Protocol and Signalling Working Group, 18 September 1989, National Security Agency, UNCLASSIFIED.

137. Private communication with Nick Neve, RSRE, UK MOD, 22 March 1990, UNCLASSIFIED.

138. Private communication with Clive Walmsley, RSRE, UK MOD, 27 March 1990, UNCLASSIFIED.

139. Briefing on OSI Security Standards, Goals of NIST, Briefing to the Protocol Standards Steering Group, DCA/NSA/NIST, 31 January 1989, UNCLASSIFIED.

140. *Security in Open Systems--A Security Framework,* ECMA TR/46, European Computer Manufacturers Association, July 1988, UNCLASSIFIED.

141. *Standard for Interoperable LAN Security (SILS),* P802.10/D1, IEEE, 6 January 1989, UNCLASSIFIED.

142. *Optional LLC Security Sublayer,* Draft Proposed Addendum to IEEE 802.2 Logical Link Control, P802.2-88/95, Third Draft, IEEE, November 1988, UNCLASSIFIED.

143. Briefing on BLACKER, INCA Project Office, US Defense Communications Agency, May 1990, UNCLASSIFIED.

144. *Defense Data Network Security,* R. W. Shirey, US Defense Communications Agency, Undated, UNCLASSIFIED.

145. *BFE Interface Control Document,* BLACKER Program Office, US Defense Communications Agency, 21 March 1989, UNCLASSIFIED.

146. *IT-Security Criteria, Criteria for the Evaluation of Trustworthiness of Information Technology (IT) Systems (German Green Book),* Zentralstelle für Sicherheit in der Informationstechnik (ZSI, German Information Security Agency), 1989.

147. *Computer Security Requirements--Guidance for Applying the Department of Defense Trusted Computer System Evaluation Criteria in Specific Environments (Yellow Book),* CSC-STD-003-85, DoD Computer Security Center, June 1985.

148. *Technical Rationale Behind CSC-STD-003-85: Computer Security Requirements--Guidance for Applying the Department of Defense Trusted Computer System Evaluation Criteria in Specific Environments (Yellow Book Rationale),* CSC-STD-004-85, DoD Computer Security Center, June 1985.

149. *Department of Defense Trusted Computer System Evaluation Criteria (Orange Book),* DoD 5200.28-STD, DoD Computer Security Center, December 1985.

150. *Trusted Network Interpretation (Red Book),* NCSG-TG-005, Version 1, National Computer Security Center, July 1987.

151. *Open Distributed Management Standards--The OSI Management Approach,* A. Langsford, Working Paper, July 1989, UNCLASSIFIED.

152. Private communication with the Chair, ANSI X3.T5.4 and head of US delegation to SC21/WG4, 15 June 1990, UNCLASSIFIED.

153. *Systems Management Tutorial - Annex A: Access Control,* SC21 N 4970, 30 May 1990.

154. *Disposition of Ballot Comments in JTC1 N 766 on the Proposal for a NWI--Management Information for the OSI Upper Layers,* SC21 N 4912, SC21/WG6, June 1990.

155. *A General Model for Relationship Management,* SC21 N 4975, SC21/WG4, 31 May 1990.

156. *Liaison Statements to SC21/WG4,* SC21 N 3851-3853, 30 August 1989.

157. *Telecommunication Management Network,* Working Document Prepared for the TSGCEE SG9 AHWG on OSI Management, Man 0290/06, February 1990, UNCLASSIFIED.

158. *NATO Requirements for Open Systems Management,* TSGCEE SG9 AHWG-OM, 28 June 1990, NATO UNCLASSIFIED.

159. *Call to National Bodies and Liaison Organizations for Contributions on Technical Structure of Quality of Service (QoS) Architecture,* SC21 N 5110, May 1990.

160. *Report to SG/9 by the Chairman of Working Group 1 on the 18th Meeting Held 26 February to 2 March 1990,* WG/1, 21 April 1990, NATO UNCLASSIFIED.

161. *Response to Q62 on Quality of Service, Chair,* AHWG-OM, 10 March 1989, UNCLASSIFIED.

162. *Liaison to SG9 Concerning Work on the Quality of Service Issue,* TSGCEE SG9 AHWG-OM, 27 June 1990, NATO UNCLASSIFIED.

163. "Management Requirements Arising from a NATO Study of Quality of Service," Paul Kennedy, Chris Sluman, and Peter Pranschke, *Integrated Network Management,* B. Meandzija and J. Westcott (Editors), Elsevier Science Publishers B.V., The Netherlands, 1989 (pp 133-140).

164. *SG9 AHWG-OSI Management Meeting Report, 25-29 June 1990, Ottawa,* US Representative to AHWG-OM, 6 July 1990, UNCLASSIFIED.

165. *Liaison Statement to CCITT SG VII (Q.23) on Collaborative Work on OSI Registration,* SC21 N 5014, 6 June 1990.

166. *Revised Text of 4th DP 9834-1,* SC21 N 4352, January 1990.

167. "OSI Conformance Testing," D. Rayner, *Computer Networks and ISDN Systems,* Volume 14, 1987, UNCLASSIFIED.

168. *Call for Contributions on OSI Conformance Issues,* SC21 N 5082, SC21/WG1, May 1990.

169. *Issues on Upper Layers Conformance Testing,* SC21 N 4187, November 1989.

170. *Study and Investigation Mandate for OSI Conformance Testing Methodology,* ITSTC N 1048, CEN/CENELEC Information Technology Steering Committee, 28 July 1989.

171. *The Tree and Tabular Combined Notation,* Annex E, ISO 4646-2, December 1987, UNCLASSIFIED.

172. *NATO Requirements for OSI Testing--Issues and Recommendations,* CA Contribution to NATO TSGCEE SG9, 15 February 1989, UNCLASSIFIED.

173. Briefing to TSGCEE SG9 on Conformance Testing, by Ralph Cardonna, US Precoordination Meeting, 30 August 1988, UNCLASSIFIED.

174. *Cooperation Agreement with Japan,* Memorandum for the Members of the COS Board of Trustees, Corporation for Open Systems, 19 June 1989, UNCLASSIFIED.

175. *Guidelines for the Application of Estelle, LOTOS and SDL, PDTR 10167,* ISO/IEC JTC1 SC21 (SC21 N 3252), February 1989, UNCLASSIFIED.

176. *Reassessment of Project 1.21.44, Architectural Semantics for FDTs,* SC21 N 4655, 20 April 1990.

177. ISO 8807/PDAD1, *Graphical Representation of LOTOS (G-LOTOS),* SC21 N 4228, December 1989.

178. *G-LOTOS: A Graphical Syntax for LOTOS,* Attachment to SC21 N 3253, December 1988, UNCLASSIFIED.

179. *Revised Report of the SC21 Strategic Planning Meeting,* SC21 N 3134, October 1988, UNCLASSIFIED.

180. *OSN: The Open Systems Newsletter,* Volume 4, Issue 3, March 1990, pp. 24-25.

181. Briefing on ISO Standards for User System Interaction, N. Bevan, et al., CHI'89 Conference, May 1989, UNCLASSIFIED.

182. "The ISO Virtual Terminal Standards," OSN: *The Open Systems Newsletter,* Vol. 3, Issue 4, Technology Appraisals, Limited, April 1989, UNCLASSIFIED.

183. *Response to SC18/WG4 N 1183, Comments on Terminal Management, and SC18/WG3 and CCITT SG VII(Q27) Liaison Statement on Terminal Management,* SC21 N 4188, SC21/WG5, December 1989.

184. *Terminal Management Model,* SC21 N 4176, SC21/WG5, December 1989.

185. "Xcellence in Windows: Advantages of a Standard," I. McCartney, *Mini-Micro Systems,* Vol. 20, No. 7, July 1987.

186. *Comments on the Integration of X-Windows Into the OSI Environment,* SC21 N 4189, December 1989.

187. "The Development of PEX--A D Graphics Extension to X11," W. H. Clifford, et al, EUROGRAPHICS '88, *Proceedings of the European Computer Graphics Conference and Exhibition,* Nice, France, 12-16 September, 1988.

188. "Windowing Systems Overview," F. D. Greco, *Program Journal,* Vol. 6, No. 4, July-August 1988.

189. "Windows and Widgets (MIT X)," R. Anderson, *Computer Systems Europe,* April 1989.

190. Briefing on X Window System Standards Update, D. Richard Kuhn, presented at the Applications Portability Profile and Open Systems Environment Users Forum, US National Institute of Standards and Technology (NIST), Gaithersburg, MD, 9 May 1990.

191. *Information Processing Systems - Computer Graphics - Reference Model of Computer Graphics,* RM/20, Second Working Draft, 3 February 1989.

192. "EDI1--CCITT Takes First Steps to X.400 and EDI Convergence," *OSN: The Open Systems Newsletter*, Vol. 2, Issue 7, Technology Appraisals, Limited, London, September 1988, UNCLASSIFIED.

193. *PAGODA Comments on DTR 10000-2 and Proposed FOD Taxonomy*, SGFS N 156, 6 November 1989, UNCLASSIFIED.

194. *Liaison Statement from JTC1/SC18 to JTC1/SC21/WG5 on Comments on Terminal Management*, SC21 N 3930, SC18/WG4, 19 October 1989.

195. *Ada 9X Project Report: Ada 9X Revision Issues*, Release 2, US Office of the Under Secretary of Defense for Acquisition, May 1990.

196. *Rationale for MIL-STD-1838A (CAIS)*, prepared by SofTech, Inc., for the Ada Joint Program Office, 30 September 1989.

197. *The C Programming Language*, Brian W. Kernighan and Dennis M. Ritchie, Second Edition, Prentice Hall, 1988.

198. *Common LISP*, G. L. Steele, Digital Press, 1984.

199. *Artificial Intelligence: An Applications-Oriented Approach*, Daniel Schutzer, Van Nostrand Reinhold Company, 1987.

200. "PCTE as a Proposed ISO," *Computer Systems Europe*, January 1989.

201. "Second PCTE+ International Review," E. J. Dowling, *Ada User*, Vol. 9, No. 3, 1988.

202. *Accueil Logiciel Futur: Overview of the Project*, J. M. Brettnacher, et al., ESPRIT '88--Putting the Technology to Use, Proceedings of the 5th Annual ESPRIT Conference, Volume 1, 1988.

203. *Facsimile communication from Alstair Kemp*, IEE, London, 10 July 1990.

204. "Proposed Standard Eases Tool Interconnection," *IEEE Software*, November 1989, pp. 69-70.

205. *GEMINI: Government Expert Systems Methodology Initiative*, T.A. Montgomery and E. Crispin, Fifth International Expert Systems Conference, London, 6-8 June 1989, pp. 45-54.

206. *Scope for MOD IT Standardization and Responsibilities*, MOD Information Technology Standards Board Executive Committee Technical Group, MODITSB 3/89, 11 August 1989, UNCLASSIFIED.

207. *Liaison Statement from SC18 to SC21/WG5 on Conference Application New Study Item Including RODE*, SC21 N 4342, January 1990.

208. "Harmonization Between Document Filing and Retrieval (DFR) and FTAM," *OSN: The Open Systems Newsletter*, Vol. 3, Issue 12, December 1989.

209. *Terms of Reference and Plan of Action for the Reassessment of JTM Full Class*, SC21 N 4356, January 1990.

210. *US Position on JTM Reassessment*, SC21 N 4641, March 1990.

211. *Position on Reassessment of JTM Full Class Protocol*, AFNOR, SC21 N 4603, March 1990.

212. *Report on SC21 Plenary, Held in Seoul, 5-6 June 1990*. IST/21:2160, July 1990.

213. *Initial List of Planned PDISPs*, SC21 N 4716, 30 April 1990.

214. *UK Government OSI Profile,* Volume I, *Introduction,* Version 3.1, Central Computer and Telecommunications Agency, London, 1990.

215. *UK Government OSI Profile,* Volume II, *Specification,* Version 3.1, Central Computer and Telecommunications Agency, London, 1990.

216. *UK Government OSI Profile,* Volume III, *Procurement Handbook,* Version 3.1, Central Computer and Telecommunications Agency, London, 1990.

217. "ISO/IEC Functional Standardisation Update," *OSN: The Open Systems Newsletter,* Vol. 2, Issue 5, Technology Appraisals, Limited, London, July 1988, UNCLASSIFIED.

218. *US and UK GOSIP Alignment,* Kevin Mills, NIST, 28 July 1990, Presented to the Military OSI Symposium at SHAPE Technical Centre, 6-8 June 1990, UNCLASSIFIED.

219. *Stable Implementation Agreements for Open Systems Interconnection Protocols,* Version 3, Edition 1, NIST Special Publication 500-177, National Institute of Standards and Technology, March 1990 (Proceedings of December 1989 NIST OSI Implementor's Workshop; basis for US GOSIP 2.0).

220. *Working Agreements Working Implementation Agreements for Open Systems Interconnection Protocols: Continuing Agreements,* Volume 2, Number 2, NISTIR 90-4247, National Institute of Standards and Technology, February 1990 (Proceedings of December 1989 NIST OSI Implementor's Workshop).

221. *The Department of Defense Open Systems Interconnection (OSI) Implementation Strategy,* The Mitre Corporation for the Defense Communications Engineering Center, May 1988, UNCLASSIFIED.

222. *Scope for MOD Information Technology (IT) Standardization and Responsibilities,* UK MOD Information Technology Standards Board, 11 August 1989, UNCLASSIFIED.

223. *Topics Proposed for Discussion at the JTC1 Workshop on Distributed Applications, Phoenix, March 1990,* SC21 N 4354, UK Contribution, January 1990.

224. *Modelling of Application Program Interfaces and Remote Procedure Calls,* SC21 N 4523, 2 April 1990

225. *X/OPEN Portability Guide (XPG3),* Third Edition, X/Open Group, 1989

226. *X/OPEN Portability Guide,* Volume 1, *System V Specification Commands and Utilities,* X/OPEN Group, Amsterdam, January 1987.

227. *Proceedings of the ISO/OSI GOSIP Conference,* November 1988, UNCLASSIFIED.

228. *Result of Formal Vote on prENV 40002,* CEN, 22 November 1989.

229. *A Technical Overview of the Information Resource Dictionary,* NBSIR 86-3700, Alan Goldfine and Patricia Konig, US National Institute of Standards and Techology, January 1988.

230. *Army Implementation of DoD and Federal Standards,* Draft, Prepared for US Army Information Systems Engineering Command by Planning Research Corporation. 8 May 1988.

231. "Open Systems Opening Up," *OSN: The Open Systems Newsletter,* Volume 2, Issue 9/10, Technology Appraisals, Limited, London, November/December 1988.

232. *Announcement of Technology Selection, Distributed Computing Environment Request for Technology (RFT),* Open Software Foundation, 14 May 1990.

233. "TOP 3.0 Update," Bharat Thacker, *MAP/TOP Interface,* Volume 3, Number 2, MAP/TOP/SME, Spring 1987.

234. *Initial Graphics Exchange Specification,* Version 3.0, ANSI DP ANS Y14.26M, 1986.

235. "OSITOP Reports on Progress," *OSN: The Open Systems Newsletter,* Vol. 3, Issue 3, Technology Appraisals, Limited, London, March 1989.

236. *Guide to the Use of Standards,* Version 3, Standards Promotion and Applications Group, January 1987.

237. "The Architecture of an Interoperable Database System Based on the OSI/RDA," Mitsuo Konoike, et al., Technical Committee 1, INTAP, International Symposium on Interoperable Information Systems, 25-27 February 1987.

238. *Use of OSI Standards in NATO--Strategic and Technical Issues,* AC/302(SG/9)D/19(Revised), United Kingdom for TSGCEE SG9, 1 March 1988, NATO UNCLASSIFIED.

239. *Use of OSI Standards in NATO--Strategic and Technical Issues,* Draft for Issue 3, Contribution by the UK to TSGCEE SG9, 4 May 1990, NATO UNCLASSIFIED.

240. *Corrigendum to the Terms of Reference for the Subgroup on Data Processing and Distribution (SG9),* AC302-D162(2nd Revise), 24 July 1985, TSGCEE, NATO UNCLASSIFIED.

241. *Report to TSGCEE by Chairman Subgroup 9,* TSGCEE SG9, 5 June 1990, NATO UNCLASSIFIED.

242. Briefing to TSGCEE SG9 on a Proposal for a New TOR for SG9, Chairman of SG9, May 1990, NATO UNCLASSIFIED.

243. *Use of OSI Standards in NATO--Strategic and Technical Issues,* Draft, Issue 3, UK Contribution to SG9, 4 May 1990, NATO UNCLASSIFIED.

244. *The TSGCEE Subgroup 9 Support Programme for OSI in Military Communications,* Ian White, Admiralty Research Establishment (ARE), UK MOD, Proceedings of the Military OSI Symposium, SP-8, Volume 1 (Unclassified Papers), File Reference 9980, SHAPE Technical Centre, 6-8 June 1990, NATO UNCLASSIFIED.

245. *The Use of OSI in Military Communications,* Ian White, Admiralty Research Establishment (ARE), UK MOD, Proceedings of the Military OSI Symposium, SP-8, Volume 1 (Unclassified Papers), File Reference 9980, SHAPE Technical Centre, 6-8 June 1990, NATO UNCLASSIFIED.

246. *Report of AC/302(TSGCEE) Meeting Held on 23-25 January 1990,* US Mission NATO, 31 January 1990, UNCLASSIFIED.

247. *Report on the TSGCEE Restructuring,* AHWG on TSGCEE Restructuring, AC/302-D/568, 14 May 1990, NATO RESTRICTED.

248. *NATO SG/9 WG/1 18-Month Work Plan,* WG/1, October 1989, NATO UNCLASSIFIED.

249. *Report to SG/9 by the Chairman of WG/1 on the 16th Meeting Held 27 February to 3 March 1989,* AC/302(SG/9)WG/1D-14, 10 May 1989, NATO UNCLASSIFIED.

250. *Report to SG/9 by the Chairman of WG/1 on the 17th Meeting Held 2-4 October 1989,* 20 October, 1989, NATO UNCLASSIFIED.

251. *Report of AC/302(TSGCEE) Meeting Held on 10-12 October 1989,* US Mission NATO, 20 October 1989, UNCLASSIFIED.

252. *Report to AC/302 SG/9 on WG/2 Activities (Brussels, February 1990),* WG/2, 14 March 1990, NATO UNCLASSIFIED.

253. *NATO as an ISO International Registration Authority,* UK Contribution to TSGCEE SG9, May 1990, NATO UNCLASSIFIED.

254. *One-Time Meeting on Naming and Addressing,* Secretary for TSGCEE SG9, 24 May 1990, NATO UNCLASSIFIED.

255. *NATO SG/9 WG/2 12-Month Work Plan,* WG/2, May 1990, NATO UNCLASSIFIED.

256. *Report of the TSGCEE Subgroup 9 on Data Processing and Distribution Meeting Held 9-11 May 1990,* US Representative (O. Schultz), May 1990, NATO UNCLASSIFIED.

257. *Draft Proposed Terms of Reference for WG3,* WG/3, 22 January 1990, UNCLASSIFIED.

258. *Transmission Independent Data Link Architecture,* ADSIA-RCA-C-10-86, 12 February 1986, NATO UNCLASSIFIED.

259. *An Architecture Based on OSI Principles for NATO Tactical Data Links,* TM-864, SHAPE Technical Centre, July 1989, NATO UNCLASSIFIED.

260. *Media Independent Data Link Architecture,* ADSIA-RCA-C-106-90, 28 May 1990, NATO UNCLASSIFIED.

261. Discussions at the US Postcoordination Meeting, TSGCEE SG9, 18-19 June 1990, NATO UNCLASSIFIED.

262. *Chairman's Report on the 10th Meeting Held at NOSC San Diego, USA, 5th to 9th February 1990,* AC/302(TSGCEE) SG/9 Ad Hoc Working Group on OSI Management, February 1990, NATO UNCLASSIFIED.

263. *NATO Requirements for Open Systems Management,* NATO/AC302 (TSGCEE)SG/9MAN.0688/01, AHWG on OSI Management, TSGCEE SG/9, 1 July 1988, NATO UNCLASSIFIED.

264. *Report on the SG/9 AHWG-OSI Management Meeting Held in San Diego During 5-9 February 1990,* US Representative (Lew Gutman), 13 February 1990, UNCLASSIFIED.

265. *Report of the 2nd Ad Hoc Meeting on ISDN, Paris, 24-26 April 1990,* AHWG on ISDN, May 1990, NATO UNCLASSIFIED.

266. *Proposed NATO Standards on Packet Mode Services,* US Contribution to the AHWG on ISDN, 24 May 1990, NATO UNCLASSIFIED.

267. *ISDN/OSI Integration: Issues, Trends, and Recommendations,* Contribution from Canada to the Initial Meeting of 29-31 January 1990, AHWG on ISDN, January 1990, NATO UNCLASSIFIED.

268. *Chairman's Report of the 8th Meeting,* AC/302(TSGCEE)SG/9 Ad Hoc Working Group on Security, May 1990, NATO UNCLASSIFIED.

269. *Base Standard for MMHS,* Working Draft, Submitted to the March Meeting of WG/2, AHWG on MMHS, February 1990, NATO UNCLASSIFIED.

270. *Military Message Handling System (MMHS) Rationale Document,* Working Draft, US Input to the February 1990 AHWG on MMHS Meeting in Brussels, 12 February 1990, NATO UNCLASSIFIED.

271. *Draft Functional Profile A/3311, Common Facilities--MTA to MTA,* Working Draft on the Message Handling System, Version 9.2, European Workshop for Open Systems (EWOS), May 1990, UNCLASSIFIED.

272. *Report to SG/9 by the Chairman of Working Group 1 on Liaison with WG/2,* WG/1, 21 April 1990, NATO UNCLASSIFIED.

273. *Military Message Handling Registration Recommendation to SG/9,* WG/2, 27 February 1990, NATO UNCLASSIFIED.

274. *Intercept Profile for the Military Message Handling System (MMHS),* Issue 2, March 1990, NATO UNCLASSIFIED.

275. *Report to AC/302 SG/9 on WG/2 Activities (Brussels, October 1989),* WG/2, 8 October 1989, NATO UNCLASSIFIED.

276. Private communication with the Chair, TSGCEE SG9 AHWG on Security, 18 June 1990, NATO UNCLASSIFIED.

277. *MMHS AHWG Input to NATO TSGCEE SG/9 WG/2--12-month Work Plan,* TSGCEE SG9 WG2, February 1990, NATO UNCLASSIFIED.

278. Briefing on NACISA Interface Initiative (NIIF) to TSGCEE SG/9 WG/1, June 1989, NATO UNCLASSIFIED.

279. *NATO Naval Intra-Ship Tactical Control and Data Handling Open Systems Interconnection, Network Independent Interface, Transport Service Definition for Connection-Mode Transmission,* Proposed Draft STANAG, 16 September 1987, NATO UNCLASSIFIED.

280. *Programme of Work 1990-1992,* Issue 1, NIAG SG/6 on the Compatibility of Naval Data Handling Equipment, December 1989, NATO UNCLASSIFIED.

281. Private communication with the US Representative to the AHWG-OM, 19 June 1990, NATO UNCLASSIFIED.

282. *Military Real Time Local Area Network,* GAM-T-103, Ministre de la Defense, Republique Francaise, 9 February 1987, UNCLASSIFIED.

283. *XTP/PE Overview,* Greg Chesson, Silicon Graphics, April 1988.

284. *XTP Protocol Definition,* Revision 3.4, Protocol Engines, Inc., Santa Barbara, California, 17 July 1989.

285. Private communication with Salvatore J. Manno, Assistant Director for International Affairs, JTC3A, 24 October 1989, UNCLASSIFIED.

286. *NATO Consultation, Command and Control (C3) Master Plan (U)*, Edition 1, AC/317-WP-66 (J-1800/77/5), Information Systems Working Group (ISWG) and Communications Systems Working Group (CSWG) of the NATO Communications and Information Systems Committee (NACISC), July 1989, NATO CONFIDENTIAL.

287. *TRI-Major NATO Commanders' Command and Control (C2) Plan (U)*, 2300.12.5/SHORC/89, Edition 4, ISWG and CSWG of the NACISC, 20 July 1989, NATO SECRET.

288. *Political Consultation and NATO Civil Emergency Planning (PCNCEP) CIS Plan (U)*, Edition 1, AC/317(WG/1)WP/36(Revised) and AC/317(WG/2)WP/51 (Revised) (J-1800/77/6), ISWG and CSWG of the NACISC, 18 July 1989, NATO CONFIDENTIAL.

289. *NATO C3 Architecture (U)*, Volume 1, *Consolidated Architecture*, NACISA/APD/C3AB(89)101, NACISA, 31 May 1989, NATO CONFIDENTIAL.

290. *NATO C3 Architecture (U)*, Volume 2, *Headquarters and Facilities Subsystem*, NACISA/APD/C3AB(89)101, NACISA, 31 May 1989, NATO CONFIDENTIAL.

291. *NATO C3 Architecture (U)*, Volume 3, *Information System Subsystem*, NACISA/APD/C3AB(89)101, NACISA, 31 May 1989, NATO CONFIDENTIAL.

292. *NATO C3 Architecture (U)*, Volume 4, *Communications Subsystem*, NACISA/APD/C3AB(89)101, NACISA, 31 May 1989, NATO CONFIDENTIAL.

293. *NATO C3 Architecture (U)*, Volume 5, *Sensor and Warning Installations Subsystem*, NACISA/APD/C3AB(89)101, NACISA, 31 May 1989, NATO CONFIDENTIAL.

294. Briefing to ATCCIS PWG on SD&IC Plans by John Briggs, ADSIA, 7 December 1988, NATO UNCLASSIFIED.

295. *Air Command and Control System Master Plan*, Volume IV, *Overall ACCS Design*, Book 2, *Generic Portion*, ACCST(86)282/057, NATO, April 1986, NATO CONFIDENTIAL.

296. *Air Command and Control System Master Plan*, Volume IV, *Overall ACCS Design Generic Portion*, ACCST(86)281-282/057(Revised)/ACC-1086, Supporting Document 4, *Structure and Characteristics of Organizational Components*, May 1988, NATO CONFIDENTIAL.

297. *NATO Staff Target (NST) for the Battlefield Information Collection and Exploitation Systems (U)*, AC/302-D/560, AC/302(PG/7)D/20 (Revised), 28 December 1988, NATO CONFIDENTIAL.

298. *BICES User Requirements (U)*, Final Draft, 3 March 1988, CS/C/EL(88)259, AC/302(PG/7) Serial 25, NATO CONFIDENTIAL.

299. *NATO Maritime Interface Coordination Center Support and Capability (NMICC) Project Data and Justification (U)*, NATO Common Funded Infrastructure, Third Revision, January 1989, NATO CONFIDENTIAL.

300. Memorandum ISM-UAK-7, NATO Military Committee, 12 January 1987.

301. *Briefing to the 22nd ADSIA Plenary on the Quadrilateral Interoperability Program*, Annex V to ADSIA-RCX-DS/22, ADSIA Staff, 17-21 October 1988, NATO UNCLASSIFIED.

302. *Quadrilateral Tactical Interface Requirement*, Version 2, Quadrilateral Interface Committee, 1 August 1988, UNCLASSIFIED (Limited Distribution).

303. *Quadrilateral Technical Interface Design Plan*, Version A.7, Quadrilateral Interface Committee, 15 April 1988, UNCLASSIFIED (Limited Distribution).

304. *Quadrilateral Test and Demonstration Management Plan*, Quadrilateral Interface Committee, 15 April 1988, UNCLASSIFIED (Limited Distribution).

305. *Quadrilateral Mapping Schema, Maneuver Control System*, CSD-TR2529, Ford Aerospace & Communications Company for US Army Communications-Electronics Command, 25 September 1987.

306. *Standard Automated Message Interface for NATO ACCIS (STAMINA)*, Version 3.0 with Amendment List 1, NACISA/ISD/CCISPT(88)394E, NACISA, 17 November 1988, NATO UNCLASSIFIED.

307. *The STAMINA Specification*, J. R. Reed, S. Goldani, and N. Sanli, NACISA, Proceedings of the Military OSI Symposium, SHAPE Technical Centre, 6-8 June 1990, NATO UNCLASSIFIED.

308. Private communication with the Chair, TSGCEE SG9 WG1, 14 March 1989, UNCLASSIFIED.

309. Briefing to the 22nd ADSIA Plenary on STAMINA and QTIDP, Annex W to ADSIA-RCX-DS/22, Rex Reed, NACISA, 17-21 October 1988, NATO UNCLASSIFIED.

310. *ADatP-3 NATO Message Text Formatting System*, Part 1, *System Concept and Description*, Third Draft, 6 October 1986.

311. *Standard Automated Message Interface for NATO ACCIS (STAMINA)*, Version 4.0, April 1990

312. *Compatibility of STANAG 4214 and GOSIP Network Layer Addressing*, US Input to WG/1, August 1988, NATO UNCLASSIFIED.

313. *Statement to TSGCEE SG/9 on STAMINA and Related Activities*, NACISA, May 1990, NATO UNCLASSIFIED.

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GLOSSARY

A	Application (profile)
AC	Armament Committee (NATO)
ACBA	Allied Command Baltic Approaches
ACC	Access Control Center (US DoD, BLACKER)
ACCIS	Automated Command and Control Information System
ACCS	Air Command and Control System
ADCCP	Advanced Data Communications Control Procedures (ANSI X3.66)
ACE	Allied Command Europe
ACIS	Access Control Information System (SDNS)
ACK	Acknowledgement
ACP	Allied Communications Publication
ACSE	Association Control Service Element (OSI Layer 7)
AD	Addendum (ISO)
ADI	Directory Application (ISP)
ADMD	Administration Management Domain
ADP	Automated (Automatic) Data Processing
ADS	Automated Data System
ADSIA	Allied Data Systems Interoperability Agency
ADatP	Allied Data Publication
AE	Application Element (OSI)
AEP	Application Environment Profile (POSIX)
AFCENT	Allied Forces Central Europe
AFNOR	Association Francaise de Normalisation (France)
AHWG	Ad Hoc Working Group
AHWG-FP	Ad Hoc Working Group on Functional Profiles (TSGCEE SG9)
AHWG-OM	Ad Hoc Working Group on OSI Management (TSGCEE SG9)
AI	Artificial Intelligence
AIE	Ada Integrated Environment
ALF	Application-Level Facility (ATCCIS)
ALS	Application Layer Structure (OSI); Ada Language System
AM	ACE Manual
AMH	Automated Message Handling; Message Handling Application Profile (ISP)
ANCA	Allied Naval Communications Agency (NATO)
ANS	ANSI National Standard (United States)
ANSI	American National Standards Institute

AOM	OSI Management Application Profile (ISP)
AOW	Asia-Oceania Workshop (Sponsored by POSI)
APDU	Application Protocol Data Unit
API	Applications Programming Interface
APP	Applications Portability Profile (NIST)
APSE	Ada Programming Support Environment
AR	U.S. Army Regulation
ARD	Remote Data Access Application Profile (ISP)
ARPANET	Advanced Research Projects Agency Network (United States)
ASCII	American Standard Code for Information Exchange
ASD	
ASE	Application Service Element (OSI)
ASME	American Society for Mechanical Engineers
ASN	Abstract Syntax Notation (OSI)
ATACC	Advanced Tactical Command and Control Center (US DoD)
ATCA	Allied Tactical Communications Agency (NATO)
ATCCIS	Army Tactical Command and Control Information System
ATCCS	U.S. Army Tactical Command and Control System
ATLR	Active Transport Layer Relay
ATOC	Allied Tactical Operations Centre
ATP	Allied Tactical Publication; Transaction Processing Application Profile (ISP)
AUTODIN	Automatic Digital Network (US DoD)
AVT	Virtual Terminal Application Profile (ISP)
AWHQ	Alternate War Headquarters
B	ISDN B Service (64 kbit/second)
BASE	Baseband
BER	Basic Encoding Rules (ASN.1)
BFA	Battlefield Functional Area
BFE	BLACKER Front End (US DoD)
BICES	Battlefield Information Collection and Exploitation Systems
BIH	Bureau International de l'Heure
BPS	BICES Pilot Study
BROAD	Broadband
BSI	British Standards Institute (United Kingdom)
C2	Command and Control
C3	Command, Control, and Communications; Consultation, Command, and Control (NATO Master Plan)
C3I	Command, Control, Communications, and Intelligence
CAD	Computer Aided Design

CAE	Common Applications Environment (X/Open)
CAIS	Common APSE Interface Set
CALS	Computer Acquisitions and Logistics Support (United States)
CAM	Computer Aided Manufacturing
CASE	Common Application Service Elements (OSI Layer 7); Computer-Aided Software Engineering
CCIS	Command, Control, and Information System
CCITT	Comite Consultatif International de Telegraphique et Telephonique (International Telegraph and Telephone Consultative Committee)
CCR	Commitment, Concurrency, and Recovery (OSI Layer 7)
CCS	Calculus of Communicating Systems (LOTOS)
CCTA	Central Computer and Telecommunications Agency (United Kingdom)
CD	Committee Draft (ISO)
CDAD	Committee Draft Addendum
CDAM	Committee Draft Amendment
CDTR	Committee Draft Technical Report
CEC	Commission of the European Community
CECOM	Communications-Electronics Command (US Army)
CEN	Comite Europeen de Normalisation (European Committee for Standardization)
CENELEC	Comite Europeen de Normalisation Electrotechnique (European Committee for Electrotechnical Standardization)
CEPT	Conference Europeenne des Postes et Telecommunications
CER	Confidential Encoding Rules (ASN.1)
CGI	Computer Graphics Interface (Interfacing)
CGM	Computer Graphics Metafile
CGMIF	Computer Graphics Metafile Interchange Format
CHILL	CCITT High Level Language
CHS	Common Hardware and Software (US Army)
CIEG	Common Information Exchange Glossary
CIGOS	Canadian Interest Group on Open Systems
CIGREF	Club Informatique des Grandes Enterprises Francaises (France)
CIS	Communications and Information Systems
CL	Connectionless (mode)
CLNP	Connectionless Network Protocol (OSI)
CLNS	Connectionless Network Service (OSI)
CLTS	Connectionless Transport Service (OSI)
CMB	Configuration Management Board
CMIP	Common Management Information Protocol (OSI)
CMIS	Common Management Information Service (OSI)
CMISE	Common Management Information Service Element (OSI)
CNAD	Conference of National Armaments Directors (NATO)

CNET	Centre National d'Etude des Telecommunications (France)
CNR	Combat Net Radio
CO	Connection Oriented (mode)
COLOC	Change of Location of Command
COMPUSEC	Computer Security
CONP	Connection-Oriented Network Protocol (OSI)
CONS	Connection-Oriented Network Service (OSI)
COS	Corporation for Open Systems
COSINE	Corporation for Open Systems Interconnection Networking in Europe (COSINE)
CONP	Connection-Oriented Transport Protocol (OSI)
COTS	Connection-Oriented Transport Service (OSI); Commercial Off-the-Shelf
CR	Central Region (NATO)
CS	Circuit Switched
CSA	Canadian Standards Association
CSMA/CD	Carrier Sense Multiple Access/Collision Detection
CSDN	Circuit Switched Data Network
CSN	Circuit Switched Network
CSNI	Communications System/Network Interoperability
CSP	Communicating Sequential Processes (LOTOS)
CSPDN	Circuit Switched Public Data Network
CSWG	Communications Systems Working Group (NACISA)
CTS-WAN	Conformance Testing Services-Wide Area Network
D	ISDN D Service (16 kbit/second)
DAD	Draft Addendum (ISO)
DAF	Framework for the Support of Distributed Applications (CCITT)
DAFTG	Database Architecture Framework Task Group (ANSI)
DAM	Draft Amendment (ISO)
DAO	Document Architecture Operations
DAP	Document Application Profile
DAPWG	DFTS Architecture and Procurement Working Group (UK MoD)
DARPA	Defense Advanced Research Projects Agency (US DoD)
DBMS	Database Management System
DCA	Defense Communications Agency (United States DoD)
DCE	Data Circuit-Terminating Equipment; Distributed Computing Environment (OSF)
DCF	Data Communications Function (CCITT M.30)
DCT	Digital Communications Terminal (US DoD)
DDL	Data Definition Language
DDN	Defense Data Network (US DoD)
DEC	Digital Equipment Corporation

DED	Digital Entry Device
DER	Distinguished Encoding Rules (ASN.1)
DFR	Document Filing and Retrieval
DFTS	Defence Fixed Telecommunications System (UK MoD)
DGITS	Directorate General of Information Technology Systems (UK MoD)
DGIWG	Digital Geographic Information Working Group
DIB	Directory Information Base (CCITT X.500)
DIN	Deutsches Institut fur Normung (Federal Republic of Germany)
DIR	Directory (CCITT X.500)
DIS	Draft International Standard (ISO)
DISA	Data Interchange Standards Association
DISC4	US Army Directory of Information Systems Command, Control, Communications, and Intelligence
DISNET	Defense Integrated Secure Network (US DoD)
DISP	Draft International Standardized Profile
DIT	Directory Information Tree (CCITT X.500)
DMA	Defense Mapping Agency
DMF	Data Management Facility (ATCCIS)
DML	Data Manipulation Language
DMRM	Data Management Reference Model
DMS	Data Management Subsystem (ACE CCISs); Defense Message System (US DoD)
DNS	Domain Name System (US DoD)
DOA	Distributed Office Applications
DOAM	Distributed Office Applications Model
DoD	Department of Defense (United States)
DoDCSC	US Department of Defense Computer Security Center
DP	Draft Proposal (ISO)
DPSN	Digital Packet Switched Network; Defence Packet Switched Network (UK MoD)
DQDB	Distributed Queue Dual Bus (local area network)
DSA	Directory Service Agent (CCITT X.500)
DSG	Distributed System Gateway
DTAM	Document Transfer and Manipulation
DTE	Data Terminal Equipment
DTED	Digital Terrain Elevation Data
DTR	Draft Technical Report (ISO)
DVI	Digital Video Interactive
EC	European Community
ECCM	Electronic Counter-Countermeasures
ECMA	European Computer Manufacturers Association
ED&C	Error Detection and Correction

EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange for Administration, Commerce, and Transport
EDIMS	Electronic Data Interchange Messaging System
EESP	End-to-End Security Protocol
EFTA	European Free Trading Association
EG	Expert Group
EIA	Electronic Industries Association
E-Mail	Electronic Mail
EMUG	European Manufacturing Automation Program (MAP) User Group
EN	European Norm (European Standard) (CEN/CENELEC)
ENV	European Norm Vornorm (European Experimental Standard) (CEN/CENELEC)
EPA	Environmental Protection Agency
EPHOS	European Procurement Handbook for Open Systems
ES-IS	End System to Intermediate System
ESPRIT	European Strategic Programme of Research and Development in Information Technology
ETSI	European Telecommunications Standards Institute
EUROCOM	Eurogroup on Cooperation of Tactical Communications Systems
EWOS	European Workshop for Open Systems
FCG	Computer Graphics Interchange Format (ISP)
FCS	Frame Check Sequence
FD	Formal Description
FDDI	Fiber Distributed Data Interface
FDI	Directory Data Definitions (ISP)
FDT	Formal Description Technique
FEC	Forward Error Correction
FIMS	Forms Interface Management System
FIPS	Federal Information Processing Standard (United States)
FLTSATCOM	Fleet Satellite Communications
FOD	Office Document Interchange Format (ISP)
FOIRL	Fiber Optic Inter-Repeater Link
FORMETS	Message Text Formatting System (NATO)
FORTRAN	Formula Translation (programming language)
FRP90	Frigate Replacement Program for the 1990s (NATO)
FSG	SGML Document Interchange Format (ISP)
FTAM	File Transfer, Access and Management (OSI Layer 7)
FTP	File Transfer Protocol (US DoD)
FUI	Flow (Control) Unnumbered Information

G-LOTOS	Graphical Representation of LOTOS
GAN	Global Area Network
GDMI	Generic Definition of Management Information (OSI)
GEADGE	German Air Defense Ground Environment
GEMINI	General Expert System Methods Initiative (United Kingdom)
GKS	Graphics Kernel System
GKS-3D	Graphics Kernel System for Three Dimensions
GOSIP	Government Open Systems Interconnection Profile
GSTN	General Switched Telephone Network
GUI	Graphical User Interface
HCI	Human-Computer Interface
HD	Harmonized Document (CEN/CENELEC)
HDLC	High-Level Data Link Control (OSI Layer 2)
HEROS	Heeres-Fuehrungsinformationssystem fur die rechnergestuetzte Operations- fuehrung in Staeben
HQDA	Headquarters, Department of the Army (US DoD)
IAB	Internet Activities Board (US DoD)
IAP	Interfaces for Applications Portability (ISO/IEC JTC1)
IBN	Institut Belge de Normalisation (Belgium)
ICD	Interface Control Document
ICSI	International Coding System Identifier
ICT	Intercept Recommendation (TSGCEE SG9)
ID	Identification
IDN	Interface Definition Notation (RPC)
IEC	International Electrotechnical Commission
IEE	Institution of Electrical Engineers (United Kingdom)
IEEE	Institute of Electrical and Electronics Engineers (United States)
IEPG	Independent European Programme Group
IER	Information Exchange Requirement
IFIP	International Federation for Information Processing
IFRB	International Frequency Registration Board (UIT)
IFU	Interworking Functional Unit (OSI Relay)
IGES	Initial Graphics Exchange Specification
IIRS	Institute for Industrial Research and Standards (Ireland)
IJMS	Interim JTIDS Message Standard
INSTAC	Information Technology Standardization Technology Committee
INTAP	Interoperability Technology Association for Information Processing (Japan)
IOF	Input-Output Facility (ATCCIS)
IP	Internet Protocol; Interoperability Parameter; Internetwork Protocol

IPM	Interpersonal Messaging (MHS Service)
IRD	Information Resource Dictionary
IRDS	Information Resource Dictionary System
ISAM	Indexed Sequential Access Method
ISDN	Integrated Services Digital Network
IS	International Standard (ISO); Intermediate System (OSI)
ISO	International Organization for Standardization; International Standard
ISODE	ISO Development Environment
ISP	International Standardized Profile
ISWG	Information Systems Working Group (NACISA)
IT	Information Technology
ITDN	Integrated Tactical-Strategic Digital Network (US DoD)
ITI	Industrial Technology Institute
ITS	Integrated Tool Set (COS)
ITSTC	Information Technology Steering Technical Committee (UK)
IUKADGE	Improved United Kingdom Air Defence Ground Environment
IVD	Integrated Voice and Data (local area network)
IWU	Interworking Unit (OSI for relay functional profiles)
JINTACCS	Joint Interoperability of Tactical Command and Control Systems (US DoD)
JIS	Japanese Industrial Standard
JISC	Japanese Industrial Standards Committee
JPEG	Joint Photographic Experts Group
JSA	Japanese Standards Association
JTC1	Joint Technical Committee One (ISO/IEC)
JTM	Job Transfer and Manipulation (OSI Layer 7)
KAPSE	Kernel Ada Programming Support Environment
KBS	Knowledge-Based System
KDC	Key Distribution Center (BLACKER, US DoD)
KG	Encryption Key Generator
KIT	KAPSE Interface Team
KITIA	KAPSE Interface Team from Industry and Academia
KMAE	Key Management Application Entity
KMAP	Key Management Application Process
KMASE	Key Management Application Service Element
LAN	Local Area Network
LAP B	Link Access Procedure, Balanced
LAP D	Link Access Procedure, Version D (used for ISDN)

LDDI	Local Distributed Data Interfaces (ANSI X3.107-109)
LLC	Logical Link Control (OSI Network Layer)
LOCE	Limited Operational Capability-Europe
LOTOS	Language of Temporal Ordering of Specification
LTDP	Long-Term Defence Plan
MAC	Media Access Control
MACF	Multiple Association Control Function
MAN	Metropolitan Area Network
MAP	Manufacturing Automation Protocol
MAPSE	Minimum Ada Programming Support Environment
MAS	Military Agency for Standardization
MCS	Maneuver Control System (US Army)
MF	Mediation Function (CCITT M.30)
MHS	Message Handling System (OSI Layer 7)
MIB	Management Information Base
MIDLA	Media-Independent Data Link Architecture (TSGCEE)
MIDS	Multinational Information Distribution System (NATO)
MIL-STD	Military Standard (US DoD)
MIM	Management Information Model (DIS 10165-1)
MILNET	Military Network (United States)
MISD	Management Information Service Definition (see CMIS)
MIPS	Management Information Protocol Specification (see CMIP)
MIS	Management Information Service (OSI); Management Information System
MIT	Massachusetts Institute of Technology
MITI	Ministry of International Trade and Industry (Japan)
MM	Mixed Mode (of Operations in DTAM)
MMHS	Military Message Handling System (see CCITT X.400-1988)
MMI	Man-Machine Interface
MML	Man-Machine Language (CCITT Z.300 Series)
MMS	Manufacturing Message Specification (MAP)
MNC	Major NATO Command
MOCS	Managed Object Conformance Statement
MOD	Ministry of Defence
MODITSB	UK MoD Information Technology Standards Board
MOTIS	Message-Oriented Text Interchange System (OSI Layer 7)
MOU	Memorandum of Understanding
MPC	Multi-Party Communications
MPDT	Multipeer Data Transmission (OSI)
MPEG	Moving Picture Experts Group
MPTM	Multi-Party Test Methods

MROC	Multicommand Required Operational Capability
MS	Message Store (MHS)
MSC	Major Subordinate Command (NATO)
MSE	Mobile Subscriber Element (US Army)
MSDSG	Multi-System Distributed System Gateway
MSP	Message Security Protocol (SDNS)
MT	Message Transfer
MTA	Message Transfer Agent (MHS)
MTS	Marine Tactical Systems (US DoD)
N	Notice (ISO Working Paper)
NACISA	NATO Communications and Information Systems Agency
NACISC	NATO Communications and Information Systems Committee
NACISO	NATO Communications and Information Systems Organization
NAEW	NATO Airborne Early Warning
NBS	US National Bureau of Standards (now NIST)
NBSIR	NBS Interim Report
NCC	National Computing Centre
NCIS	NATO Common Interoperability Standards
NDI	Nondevelopmental Item
NDL	Network Database Language (OSI)
NEC	Northern European Command
NEF	Network Element Function (CCITT M.30)
NET	Telecommunications European Norm
NFR90	NATO Frigate Replacement for the 1990s
NFS	Network File Service
NIAG	NATO Industrial Advisory Group
NIIF	Network Independent Interface (NIAG SG6)
NIIS	NATO Interconnected Information System
NILS	Network Internal Layer Structure
NIMP	NATO Interoperability Management Plan
NIPD	NATO Interoperability Planning Document
NIS	NATO Identification System
NIST	US National Institute of Standards and Technology
NLR	Network Layer Relay
NM	Network Management
NMICC	NATO Maritime Interface Coordination Centre
NMOS	NATO Maritime Operational Intelligence Support
NMSIG	Network Management Special Interest Group (NIST OSI Implementor's Workshop)
NNI	Nederlands Normalisatie-Instituut (Netherlands)
NOIW	NIST OSI Implementor's Workshop

NOSA	NATO OSI Security Architecture
NPICS	NATO Protocol Implementation Conformance Statement
NPDU	Network Protocol Data Unit
NPS	Nuclear Planning System
NSA	National Security Agency (United States)
NSAI	National Standards Authority of Ireland
NSAP	Network Service Access Point (OSI)
NSS	National Standards System (Canada)
NST	NATO Staff Target
NTIS	NATO Technical Interoperability Standards
NTP	Network Time Protocol
NWI	New Work Item
ODA	Office Document Architecture
ODIF	Office Document Interchange Format
ODL	Office Document Language
ODP	Open Distributed Processing
OM	OSI Management
OSCRL	Operating System Command and Response Language
OSE	Open System Environment (NIST)
OSF	Open Software Foundation; Operation System Function (CCITT M.30)
OS	Operating System
OSI	Open Systems Interconnection
OSITOP	Open Systems Interconnection for Technical and Office Protocol
OSN	Open System Newsletter (London)
PAD	Packet Assembly/Disassembly
PCDAM	Proposed Committee Draft Amendment (ISO)
PCNCEP	Political Consultation and NATO Civil Emergency Planning
PCTE	Portable Common Tool Environment
PER	Packed Encoding Rules (ASN.1)
PDAD	Proposed Draft Addendum (ISO)
PDAM	Proposed Draft Amendment (ISO)
PDIF	Product Definition Interchange Format
PDISP	Proposed Draft International Standardized Profile
PDL	Page Description Language
PDN	Public Data Network
PDTR	Proposed Draft Technical Report
PDU	Protocol Data Unit
PHIGS	Programmer's Hierarchical Interactive Graphics System
PHY	Physical

PICS	Protocol Implementation Conformance Statement
PIF	Page Image Format (ANSI X3.98)
PLP	Packet Level Protocol (X.25)
PLPS	Presentation Level Protocol Specification
PM	Processable Mode (of Operations in DTAM)
PMD	Physical Layer Medium Dependent
POSI	Promoting Conference for OSI (Asia-Oceania Regional Workshop)
POSIX	Portable Operating System Interface for Computer Environments
PPSC-IT	Public Procurement Subcommittee in the Information Technology Sector (CEC)
prENV	Draft European Prestandard
PRMD	Private Management Domain
PSC	Principal Systems Command; Principal Subordinate Command
PSDN	Packet Switched Digital Network
PSPDN	Packet Switched Public Data Network
PSSG	Protocol Standards Technical Panel (US DoD)
PSTN	Public Switched Telephone Network
PSSG	Protocol Standards Steering Group (US DoD)
PTI	Public Tool Interface
PTLR	Passive Transport Layer Relay
PTT	Post, Telephone, and Telegraph
PVC	Permanent Virtual Circuit
PWG	Permanent Working Group
Q&A	Question and Answer (NATO Identification System)
QIP	Quadrilateral Interoperability Programme
QoS	Quality of Service
QSTAG	Quadrilateral Standardization Agreement
QTDMP	Quadrilateral Test and Demonstration Management Plan
QTIDP	Quadrilateral Technical Interface Design Plan
QTIR	Quadrilateral Technical Interface Requirements
R	Relay (profile)
RA	CLNS Relay Profile (ISP)
RACWG	Requirements and Design Criteria Working Group
RARE	Reseaux Associes pour le Recherche Europeenne (Association of European Research Networks)
RB	CONS Relay Profile (ISP)
RC	X.25 Relay Profile (ISP)
RD	MAC Relay Profile Using Transport Bridging (ISP)
RDA	Remote Data Access (OSI)
RDT	Referenced Data Transfer

RE	MAC Relay Profile Using Source Routing (ISP)
RFC	Request for Comment
RFT	Request for Technology
RM	Reference Model
RO	Remote Operations
RODE	Remote Open Document Editing
ROS	Remote Operation Service (OSI)
ROSE	Remote Operation Service Element (OSI)
RPC	Remote Call Procedure
RT	Reliable Transfer
RTS	Reliable Transfer Service (OSI)
RTSE	Reliable Transfer Service Element
RTTS	Real-Time Transport Service
RWS-CC	Regional Workshop Coordinating Committee
RZ	CLNS to CONS Relay Profile (ISP)
SANISI	Security Architecture for NATO Information Systems Interconnection
SACF	Single Association Control Function
SAO	Single Association Object
SAP	Service Access Point; Subnetwork Access Protocol (Network Layer)
SASO	Saudi Arabian Standards Organization
SATCOM	Satellite Communications
SC	Sub-Committee (ISO); Study Committee
SCARS	Status Control Alerting and Reporting System
SCC	Standards Council of Canada
SCF	Service Control Facility (ATCCIS)
SCSI	Small Computer System Interface
SD&IC	System Design and Integration Contract (ACE ACCIS)
SDCP	Subnetwork Dependent Convergence Protocol (OSI Network Layer)
SDIF	SGML Document Interchange Format
SDL	System Development Language (FDT)
SDNS	Secure Data Network System (U.S. National Security Agency)
SDTS	Spatial Data Transfer Specification
SECAN	Military Committee Communications Security and Evaluation Agency (NATO)
SFS	Suomen Standardisoimisliitto (Finland)
SG	Subgroup
SGFS	Special Group on Functional Standardization (ISO/IEC JTC1)
SGML	Standard Generalized Markup Language
SHAPE	Supreme Headquarters Allied Powers Europe

SICF	Systeme Informatique de Commandement des Forces Terrestres (Information System for Command of Ground Forces, France)
SICP	Subnetwork Independent Convergence Protocol (OSI Network Layer)
SIG	Special Interest Group (NIST OSI Implementor's Workshop)
SILS	Standard for Interoperable LAN Security
SINCGARS	Single-Channel Ground/Air Radio System (US DoD)
SIS	Standardiseringskommisionen i Sverige (Sweden)
SMF	System Management Facility (ATCCIS)
SMI	Structure of Management Information (OSI)
SMS	Swedish Mechanical Standardization
SMTP	Simple Mail Transfer Protocol (US DoD)
SN	Subnetwork
SNDCP	Subnetwork Dependent Convergence Protocol (OSI Network Layer)
SNICP	Subnetwork Independent Convergence Protocol (OSI Network Layer)
SNPA	Subnetwork Point of Attachment
SOGITS	Senior Official Group for Information Technology Standardization (CEC)
SOGT	Senior Official Group on Telecommunications (CEC)
SP	Security Protocol (SDNS)
SPAG	Standards Promotion and Applications Group
SPARC	Standards and Planning Requirements Committee
SQL	Standard Query Language (ISO)
SSI	System Software Interface
SSP	Subnetwork Specific Protocol (Network Layer)
STAMINA	Standard Automated Message Processing Interface for NATO's ACCISs
STANAG	NATO Standardization Agreement
STC	SHAPE Technical Centre
STE	Signalling Terminal
STL	Standard Text Language
STN	Switched Telephone Network
STRIDA	Systeme de Traitement et de Representation des Informations de Defense Aerienne
STUR	Specification Technique d'Utilisation Raccordement
SUCOC	Succession of Command
SVID	System V Interface Definition
SWG	Special Working Group (ISO JTC1)
T	Transport (profile)
TA	Connection Mode Transport Profile Using CLNS (ISP)
TACSATCOM	Tactical Satellite Communications

TADIL	Tactical Data Link
TAIS	Target Architecture and Implementation Strategy (US DoD, DMS)
TAOM	Tactical Air Operations Module (US DoD)
TB	Connection Mode Transport Profile Using CONS (ISP)
TBD	To Be Determined
TC	Transport Connections; Technical Committee (ISO); Connection Mode Transport Profile Using TP0/TP2 Over CONS (ISP)
TCIS	Technical Common Interface Standards (TSGCEE SG9)
TCOS	Technical Committee on Operating Systems (IEEE)
TCP	Transmission Control Protocol (US DoD)
TCS	Trusted Communications Sublayer (SANISI)
TCSEC	Trusted Computer System Evaluation Criteria (Orange Book)
TD	Connection Mode Transport Profile Using TP0 Over CONS (ISP)
TE	Connection Mode Transport Profile Using TP2 Over CONS (ISP)
TEK	Traffic Encryption Key
TF	Transfer Facility (ATCCIS)
TFA	Transparent File Access (POSIX)
TIDP	Technical Interface Design Plan
TLV	Tag-Length-Value
TM	Technical Memorandum; Terminal Management
TMD	Terminal Management Domain
TMN	Telecommunication Management Network (CCITT M.30)
TOP	Technical and Office Protocol
TOR	Terms of Reference
TP	Transaction Processing (OSI); Transport Protocol (OSI); Transport Class (OSI)
TPDU	Transport Protocol Data Unit (OSI)
TPSUI	Transaction Processing Service User Invocation
TR	Technical Report (ISO)
TRI-TAC	Joint Tactical Communications Program (US DoD)
TS	Transport Service (OSI)
TSA	Time Synchronization Agent
TSG	Technical Study Group (ISO/IEC JTC1)
TSGCEE	Tri-Service Group on Communications and Electronic Equipment (NATO)
TTC	Telecommunications Technology Committee (Japan)
TTCN	Tree and Tabular Combined Notation (ISO)
UA	User Agent (MHS); Connectionless Mode Transport Profile Using CONS (ISP)
UB	Connectionless Mode Transport Profile Using CLNS (ISP)
UER	Union Europeenne de Radiodiffusion
UIMS	User Interface Management System

UIT	Union Internationale des Telecommunications (CCITT)
UK	United Kingdom
ULA	Upper Layer Architecture (OSI)
UN	United Nations
US	United States
USGS	United States Geological Survey
UTACCS	USAREUR Tactical Command and Control System
UTE	Union Technique de l'Electricite (France)
VDT	Visual Display Terminal
VPS	Vector Product Standard
VSAT	Very Small Aperture Terminal
VT	Virtual Terminal (OSI Layer 7)
VTE	Virtual Terminal Environment
VTP	Virtual Terminal Protocol
WAN	Wide Area Network
WD	Working Draft
WDAD	Working Draft Addendum (ISO)
WDAM	Working Draft Amendment (ISO)
WDISP	Working Draft International Standardized Profile
WDTR	Working Draft Technical Report
WG	Working Group
WP	Working Paper (ATCCIS)
WSF	Workstation Functional (CCITT M.30)
WWMCCS	World Wide Military Command and Control System
XALS	Extended Application Layer Structure
XID	Exchange Identification
XPG3	Third Edition of the X/Open Portability Guide
XSI	X/Open System Interfaces
XTP	Xpress Transfer Protocol
XVS	X/Open System V Specification
ZSI	German Information Security Agency

INDEX